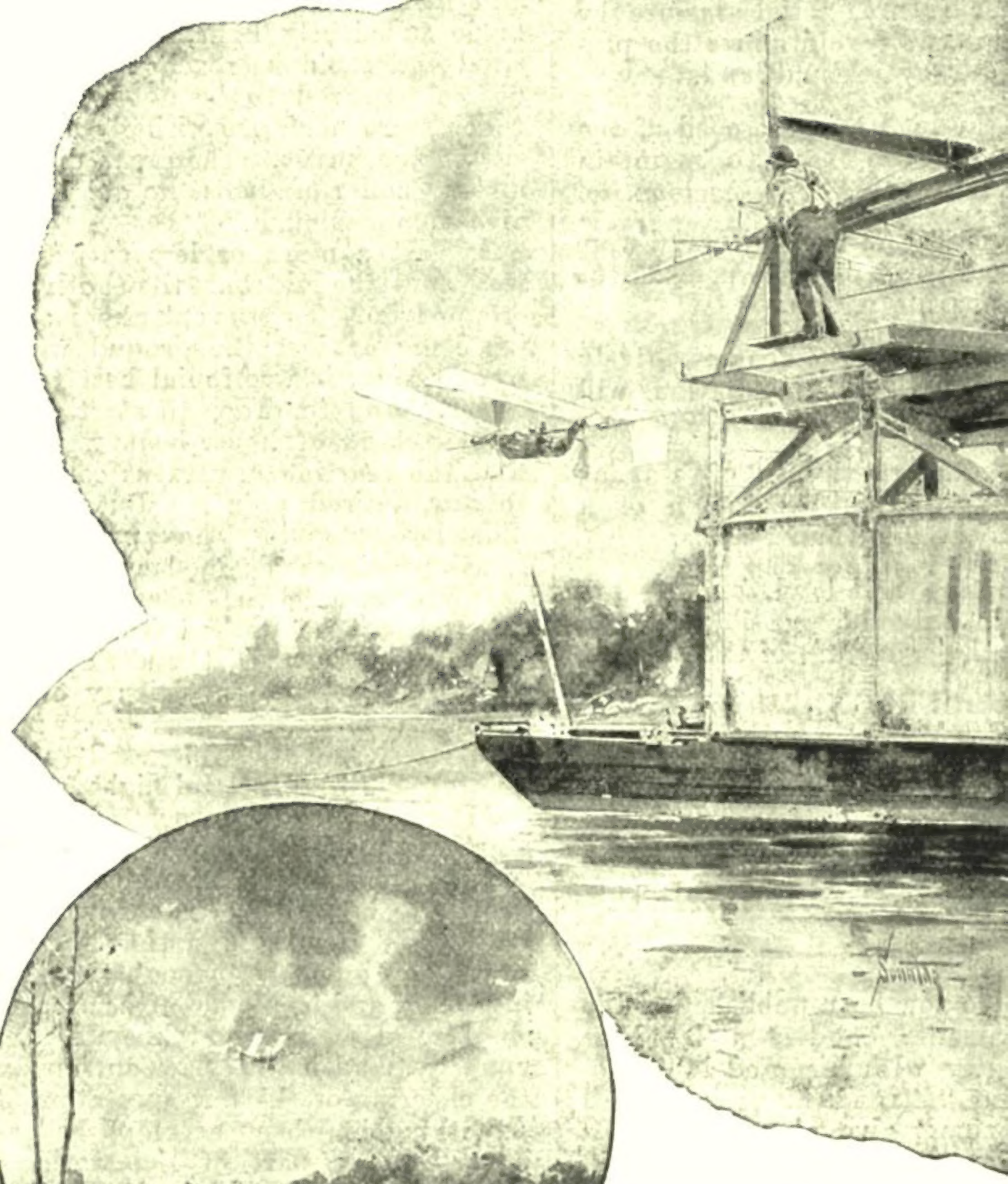


The Aeronautical journal

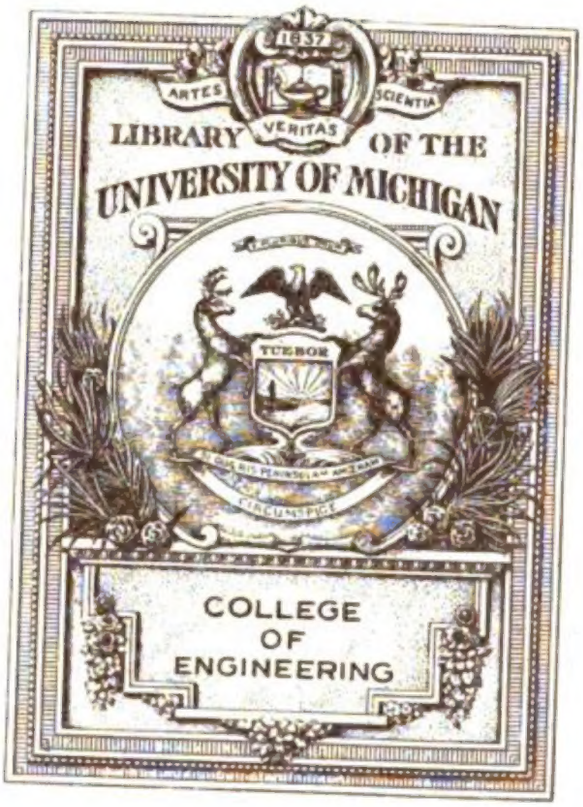
Royal Aeronautical Society

ing of the

"AERODROME.

Digitized by Google

From the *Strand Magazine*.]


1837
ARTES
SCIENTIA
VERITAS
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
TUEBOR
COLLEGE
OF
ENGINEERING

by Google

TL
501
.R888

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

THE

AERONAUTICAL JOURNAL.

A QUARTERLY ILLUSTRATED MAGAZINE DEVOTED TO ALL SUBJECTS CONNECTED WITH THE NAVIGATION OF THE AIR.

VOL. I.

1897.

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, LONDON, E.C.

Digitized by Google



Digitized by Google

AERONAUTICAL JOURNAL.

VOL. I.

Eng. Stechert

INDEX.

Journal No. and Page.

Accidents, 4·19; Lilienthal, 1·11; Wolfert, 3·14; balloon 3·16
Aerodrome 1·5, 2·1
Aeronautical Society, The ..1·3, 1·9, 2·1, 3·1, 4·1
„ Annual 3·18
Alderson, C. H. 1·3
Andrée 1·13, 3·16, 4·17
Archibald, Douglas, book by 4·21
Arctic ballooning .. 1·13, 2·8, 3·16, 4·17, 4·20
Arnold, Sir E. 1·3
[4·1, 4·17
Baden-Powell, Capt. 1·4, 1·5, 2·3, 2·5, 2·17, 3·19,
Balloon—
Andrée's 1·13, 3·16, 4·17
Dr. Wolfert's 1·2, 1·13
Exploring 2·11
Polar 2·8, 4·17, 4·20
War 2·11, 2·12, 4·18
Zeppelin's 3·16
Barnard's Air Ship 3·17
Books on Aeronautics .. 1·16, 2·14, 3·14, 3·18, 4·20
Boomerangs 3·16
Briarey, F. W. 1·4, 1·9

Cattle, S. 2·1
Cellular Kites 2·9
Challis, T. G. 2·13
Chanute, O. 1·13
Compressed Air Motors 2·5
Cook, T. D. 2·18
Coxwell, H. 1·13, 4·20

Davidson, G. L. O. 4·19

Earle, Dr. 1·3
Elsdale, Col. 3·1
Engines, Light 1·4, 3·16

Fergusson, S. P. 1·13
Fitzgerald, Prof. G. F. 2·1
Flying Machines—
Chanute 1·13
General 1·4, 2·1, 2·13, 3·1
Langley's 1·5, 2·1, 3·9
Lilienthal's 1·11
Pilcher's 2·1, 3·17, 4·24
Richet's 1·13, 4·19
Stenzel's 1·13
Flying Fox 4·2
Frankfort de Montmorency, Lord 2·1
Fraser, T. 1·14, 3·22
Fullerton, Major, 1·3; on "Flight" 2·1

Glaisher, J. 1·3
Goff, W. G. D. 3.1
Gordon, N. R. 2·13
Gunpowder Motor 2·13

Hargrave, L. 2·6, 2·9, 3·1, 3·15, 4·1
Hoffmann, J. 3·21

International Balloon Ascents 3·17

Jenkins, Rhys 2·5
Jensen, P. 2·18
Johnson, V. E. 3·13

Journal No. and Page.

Kites 1·5, 1·13, 1·16, 2·9, 2·14, 2·17, 3·17, 3·20, 4·20
„ Man-lifting 1·5, 2·5, 4·20
„ for Meteorology 2·12, 2·14, 3·17, 4·20
„ for Life-saving 4·19
„ Books on 1·16, 2·14, 3·18, 4·20
„ Cellular 2·9
Kosch, R. 1·14

Lamson, C. H. 4·20
Langley, Prof. S. P. 1·5, 2·1, 3·9
Lilienthal, 2·1; death of 1·11

Macdonald, T. 1·15, 3·1
Marshall, J. 1·15, 3·1
Martin, L. 1·14
Marvin, Prof. C. F. 4·20
Maxim, H. S. 1·3, 2·3
Meteorological Forecasts 2·13
Middleton, H. 2·18
Moore, Major, patent, 1·14; paper by .. 4·2
Motors 3·15
„ Gunpowder 2·10
„ Compressed Air 2·5
„ Steam 3·10, 3·15

Oakes, E. 2·4
Olivas, E. C. 1·14

Parakites 1·16
Patents 1·13, 2·17, 3·21, 4·22
Pearse, A. 2·1
Pennington, E. J 3·21, 4·23
Phillips, Capt. 2·1
Pilcher, P. S. 2·1, 3·17, 4·24
„ Lecture by 2·1
Polar Ballooning .. 1·13, 2·8, 3·16, 4·17, 4·20
Propellors, Hargrave's 3·15
„ Waelde's 4·19

Richet, Dr. 1·13, 4·19
Riedinger, A. 2·18
Roots, J. 4·22
Rotch, A. L. 3·17, 4·20
Rules, Aeronautical Society, revision of .. 1·3
Russian War Balloons 2·11
„ Aeronautical Exhibition 4·20

Scott, R. 4·23
Sly, W. C. 1·14
Soaring Flight 2·4
„ Machines 1·12, 2·13, 3·17
Speed of Flying Birds 1·13, 3·17
Spencer, P. 2·1
Spiers, Capt. 4·19
Stentzel 1·13

Upper Rhine Aeronautical Society .. 2·12, 3·19
Urquhart, R. J. 1·3

Waelde 4·19, 4·23
Warren, Sir C. 2·1
Wise, Lieut. 2·7
Woglom, G. T. 1·16
Wolfert, Dr. 1·13, 3·14

Zepplin, Count 3·16

Digitized by Google

LIBRARY
620.5
A2 45

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF MICH
AUG 4 1910

THE

AËRONAUTICAL JOURNAL



No. 1. JANUARY, 1897. Vol. 1.

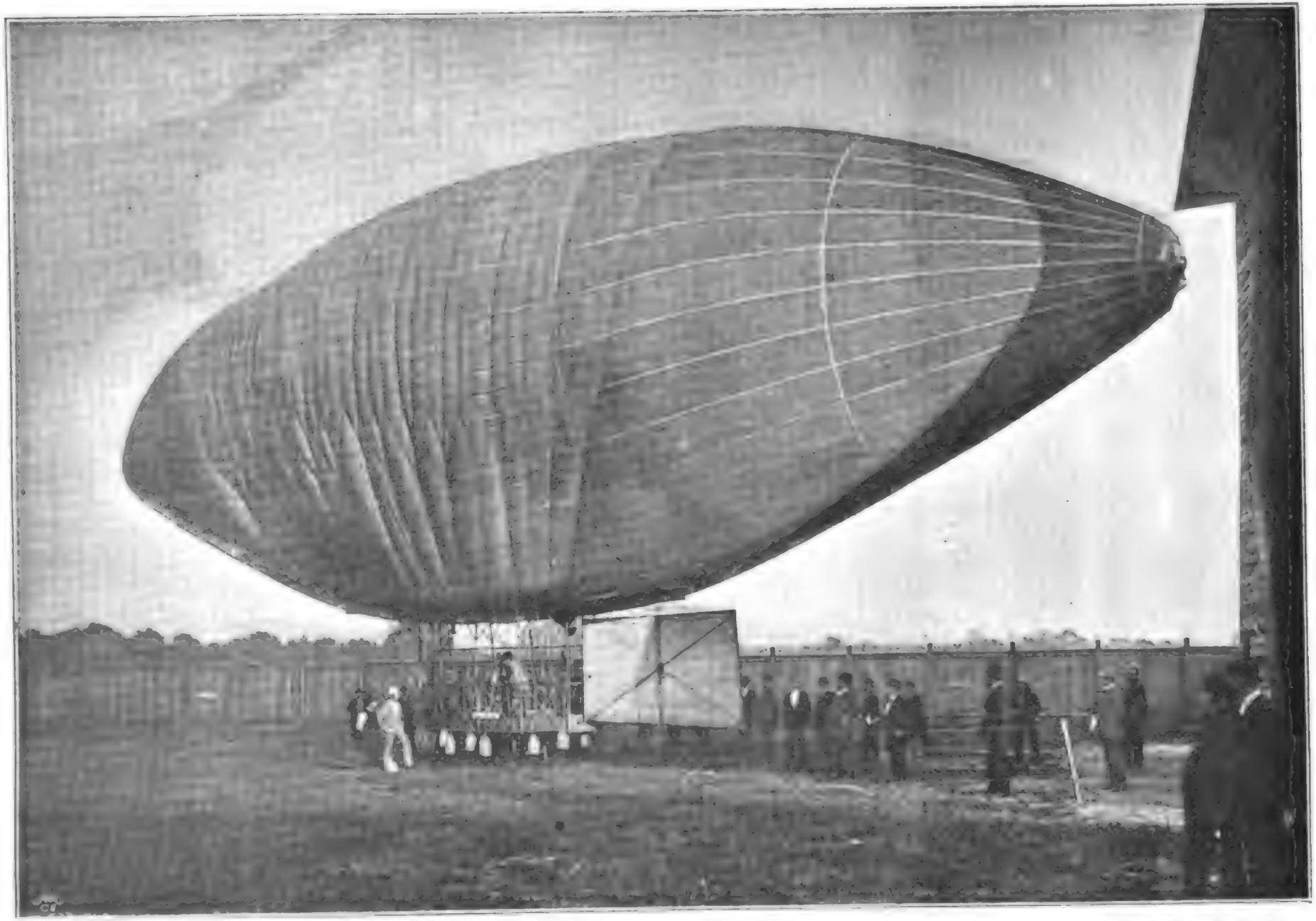
Contents.

	PAGE.
Notices, &c.	3
The Aeronautical Society	3
The Present State of Aeronautics	4
Langley's Flying Machine	5
The Late Mr. Brearey	9
The Death of Lilienthal	11
Dr. Wolferts' Steerable Balloon	13
Speed of Flying Birds	13
Summary of News	13
Recent Patents	13
Recent Publications, &c.	16
Notable Articles in Periodicals during 1896.	16

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google



From the St. James's Budget.

DR. WOLFERTS' STEERABLE BALLOON. *Vide Page* 13.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JANUARY, 1897.

Communications respecting Advts. to be addressed to the Publishers,

THE AERONAUTICAL SOCIETY OF GREAT BRITAIN,

8, St. George's Place, London, S.W.

NOTICES OF The Aeronautical Society.

Meetings of the Council were held on Nov. 30th and on Dec. 19th, 1896.

The following gentlemen have been elected Members of the Society, viz. :—

Dec. 19. R. J. URQUHART,
C. H. ALDERSON,
SIR EDWIN ARNOLD, K.C.I.E., &c.,
DR. EARLE.

The following gentlemen have been elected *honorary members* in recognition of their long and valuable services to the cause of Aëronautics, viz. :—

MR. JAMES GLAISHER, F.R.S.,
MR. HENRY COXWELL.

The following Members have been elected to the Council, viz. :—

Dec. 19. MR. HIRAM S. MAXIM,
MAJOR J. D. FULLERTON, R.E.,
SIR EDWIN ARNOLD K.C.I.E., &c

Some revisions of the Rules of the Society have been sanctioned. The principal alterations are :—

Rule II., paragraph 2, *delete* "four" before Vice-Presidents (so that the number of Vice-Presidents is not specified).

Rule II., paragraph 2, *for* "twelve" *read* "six." (The Council to consist of President, &c., and at least *six* other Members.)

Rule V., paragraph 2, *for* "the day of his election" *read* "the first of January." (All subscriptions to count from Jan. 1st in each year.)

Rules XVII., XVIII., and XIX. to be struck out. (These have reference to experimental balloon ascents, inventions submitted, and donations.)

A Meeting of the Society for the reading and discussion of papers and exhibition of models will be held about the end of March. The exact date and all further particulars will be notified hereafter. Any Members having papers or models to submit are requested to communicate with the Hon. Secretary.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

8, ST. GEORGE'S PLACE,
LONDON, S.W.

The Aeronautical Society.

During the last few years this Society has been in a somewhat morbid and languishing condition. It may be likened to a sick child, who sinks until he is on the very verge of death, and yet recovers, and regains more than his former health.

It may not be inappropriate in this first number of the new Journal to review shortly the past history of the Society.

Just thirty-one years ago—on the 12th of January, 1866—a group of men, including some of the most eminent scientists of the day, met together at the house of the Duke of Argyll for the purpose of founding a Society "for the advancement of Aerial Navigation and for observations in Aerology connected therewith." The Duke of Argyll was elected President, the Duke of Sutherland, Lord Richard Grosvenor (now Lord Stalbridge), and Lord Dufferin, Vice-Presidents. The Council included such names as Sir Charles Bright, M.P., Dr. (afterwards Sir William) Fairbairn, Sir C. W. Siemens, Mr. Glaisher, and many others, and Mr. F. W. Brearey was appointed Hon. Secretary. On June 20th the first meeting was held, when a paper "on Aerial Locomotion" was read by Mr. F. H. Wenham, which to this day remains one of the most interesting of the many which have since been read at the annual meetings of the Society.

During the second year of its existence the Society continued to prosper. Two meetings were held, and in the second annual report, it is stated "The Society has good reason for con-

Digitized by Google

gratulation, that since its formation so many fresh minds have been induced to study the question of aerial locomotion." In the first year the members numbered 65, while in the second they had increased to 91, and in the third to 106.

In 1868 was held the first exhibition of the Society "for the purpose of giving wide publicity to the suggestions, and form of machines proposed by different inventors, and by thus arranging their ideas so as to be seen at one view collectively, it was expected that some errors would be eliminated, and if a tendency to success in one direction could be perceived, it would greatly advance the science, by causing inventors to work more in unison, and direct their labours in a channel most likely to lead to a successful result."

The Exhibition took place at the Crystal Palace, commencing on June 25th, and numerous models were shown. The light motive power engines were probably the most important section of exhibits, a prize of £100 having been offered by the Society for the best shown. Sixteen models were exhibited and the prize was awarded to Mr. Stringfellow whose steam engine, giving rather more than one horse-power, only weighed 13 lbs. with boiler. Full particulars of all the exhibits have been published in the reports of the Society.

In 1871 some interesting experiments were conducted in aerodynamics under the auspices of the Society, by means of a powerful current of air driven through a tube.

For some years the Society kept on in much the same state, but then the numbers gradually declined. Less interest seemed to be taken in the subject, and though meetings for the reading and discussion of papers took place annually members began to realise that they were not getting enough for their money. The reports then became late and irregular, and two years' work was compressed into a report. Most of the leading lights of the Society became less active in their support and it was left to Mr. Brearey to do what he could to keep it going. But the honorary secretary was getting an old man, and was unable to impart much life into the steadily declining institution. After his death it appeared as if the Society must die with him. Not a single member of the original council was left who cared to render active support. Mr. Glaisher, in his 88th year, is the only one now remaining connected with the Society, though his great age debars his taking any energetic action in its cause. The Society still lingered on, till last year, when a few members of the council at last met together, and on November 30th it was decided to endeavour to resuscitate the Society, and see what could be done to place it on a useful footing.

Meanwhile much had been done in this branch of science outside the Society. Maxim's great machine had been built, and had attracted much attention. Lilienthal in Germany had aroused public interest in his soaring experiments. Langley, in America, had conducted a remarkable series of experiments in aerodynamics, and Chanute had brought out his book, "Progress in Flying Machines," which was the first really good and complete account of the subject ever published. The result was that the call to arms was eagerly responded to. Numbers of new members flocked to the standard. The crisis had passed! The true life-blood flowed again. The invalid has risen from its bed fresh and invigorated. May it thrive on, and grow into a healthy adult!

Present State of Aeronautics.

The following interview from *The Sunday Times* of June 14th, 1896, gives a good idea of how the subject stands at the present time :—

The invention of a flying machine, or, rather, the announcement of a sanguine inventor who believes he has accomplished this, must be to the editor of a paper almost as valuable as the appearance, or reported appearance, of a sea serpent. Again and again do we see paragraphs in the newspapers announcing some marvellous advancement towards the solution of this intricate problem, but as often as not, or a great deal oftener, the invention proves to be merely a design, or an idea, formed by one who has but little real knowledge of the subject. During the last few years, however, several men of undoubted scientific ability and inventive genius have entered the arena, and have proved, both by figures and by experiment, that a flying machine is a possibility, and has come within the range of practical invention. The careful scientist is, however, just the man who does not, as a rule, announce his device and publish full descriptions of it until he is fully convinced that he is on the right track. It is, for this reason, rather difficult to get at the truth as regards the present position of the subject. It will, therefore, be unnecessary for me to refer to the many vague reports one has seen in the papers, except as regards those I know something about. Some rumours have latterly come out about a machine devised by Professor Langley, of the Smithsonian Institute, at Washington. He is, I know, a most capable man, for he has written a book, "Aerodynamics," which, without doubt, is by far the most elaborate scientific study of the question that has been written. He has for years made most careful experiments, and has deduced many facts with reference to the action of the air on bodies moving through it of the greatest importance to inventors of aerial machines. He seems now to have made some small machine which is reported to be a great success, though I imagine it is nothing more than a model. No full description of it has, I believe, been published, and in all probability the inventor will not hurry to make common property that which has taken him so many years of study and experiment to evolve, at all events until he has progressed sufficiently to be sure of success.

Digitized by Google

Then there is the great Maxim machine. Here again we have a very capable and very careful inventor devoting his attention and his money to the subject. The result has been a truly marvellous machine. Doubtless the inventor himself expected better results than it has proved capable of supplying, but nevertheless, though the machine can scarcely be said to have left the earth, yet it has proved a great success as regards the construction of very large and very light apparatus provided with immensely powerful engines. No one, before this was constructed, could have believed in the practicability of making a steam engine of 300 horse power, and placing it in a flying machine presenting some thousands of square feet of surface to the air, the whole apparatus only weighing some three tons.

However, the affair was altogether too large and unwieldy. A slight gust of wind getting under this enormous awning would be apt to upset the whole thing, and do hundreds of pounds' worth of damage. Probably if the machine had really been shot off into mid-air it would have gone all right, but there was an awkward uncertainty as to how it might come down! I think myself it ought to have been supplied with air bladders, and sent over a cliff out to sea. Then when it fell in the water it would have floated. Now, however, Mr. Maxim talks of constructing a much smaller machine on the same lines, and I shall certainly look forward with the greatest interest for the result, as I believe it will come very near the goal we are searching for.

This machine, and probably Langley's as well, is on what is known as the aeroplane principle; that is, a large fixed plane presenting a small angle to the air is propelled horizontally at a great speed by means of screw propellers, and is forced upwards by the pressure of the air on its under side. It is really simply a large kite, which, instead of being held by a string for the wind to act on it, is driven through the air, and raised much as a kite is when drawn along by its string. This principle has been proved theoretically to give the best results, that is to say, that with a given amount of power a greater weight can be raised by this system of propelling a plane surface presenting a small upward angle to the horizontal. Lord Kelvin and others have, however, pointed out that, notwithstanding this, a machine with vertical screw propellers to lift it straight upwards might have better practical results, even though more power might be required.

Then a good deal of talk is being made about two other inventors, Lilienthal, in Germany, and Pilcher, in England. These machines are very similar in principle, and though of great interest as experimental apparatus, cannot at present be considered as much more than parachutes. They partake of the nature of large wings attached to the human body, and are, therefore, comparatively well under control, but are only capable of "flying" if launched from some high place against the wind; both inventors, however, propose to apply small engines to propel them through the air, and success depends upon whether they can get sufficiently powerful engines without greatly increasing the size of the apparatus, and if they can get sufficently efficient propellers to drive them at the requisite speed.

You ask also about the Italian machines. All I know is that reports have appeared of the Italian Government being in possession of a number of "air-ships"—and all I can say is that until I hear more of the details I don't believe a word of it.

Navigable balloons I look upon as a different subject. We know, of course, that the French have some, and, as to other nations, my mouth is closed as regards all I know in this line, but I may say at once that though on certain particular occasions, with favourable, i.e., calm weather, they may prove of the very greatest value in war, yet they are so dependent on the absence of wind and other circumstances that I cannot believe they will ever be very much used.

Then as for my own apparatus. Well, that again, is quite another matter. It is not a flying machine in the ordinary acceptance of the term. It is simply a system of large kites only for captive use. That is to say, it is held by a rope to the ground, and is chiefly for use as a lofty observatory for looking over the enemy's lines, and watching the country round about. I believe there are also other useful purposes to which it may be applied, since the length of the tether line is practically unlimited, but I need not speculate on future possibilities. My present object is to get an apparatus to serve instead of a captive balloon without necessitating the transport of cumbersome filling apparatus.

Kite-flying is not so simple a matter as some may suppose. To make an enormous kite like a toy one would be no easy task. Remember, the tail should be as heavy as the kite itself, which would, in my case, amount to some 60 lbs. or more. And then the liability to dive must be done away with, else I am afraid there might be a difficulty in providing observers. My present apparatus, which is now undergoing its trials at Aldershot, folds up so compactly that it can be carried by one man. It is capable of lifting a man to a height of 200 or 300 ft. One thing may be said about it that, besides the balloon, it is the only means known by which a man has been absolutely raised to any height in the air. And it is not entirely dependent on wind, since in calms it may be made to ascend by towing it with horses.

As for the general question of the possibilities of human flight, I for one firmly believe it will come about, and that very soon. It is, of course, in war that its great importance will be apparent. And if it be found necessary to have a large, complicated, and costly machine to effect the purpose, doubtless it will be used for little else. The first nation which can provide a secret flying-machine—and the secret will probably be more in the smaller details of construction than in the general principle—will undoubtedly possess an incalculable advantage in war.

B. BADEN-POWELL.

Langley's Flying Machine.

Professor S. P. Langley has kindly sent us the following account of his "Aerodrome," written by F. G. Carpenter for several American newspapers. This description

Digitized by Google

may, therefore, be taken as trustworthy :—

Within the past few months an invention has been made here at Washington which promises to revolutionize the travel of the world. It may transfer the vessels of the ocean to the air and carry the locomotives among the clouds. The development of it will in all probability change the warfare of the world, and it may make war so terrible that the national troubles of the future will be settled by arbitration. I refer to Mr. Langley's "aerodrome." The word means air-runner, and the machine is such that it runs faster upon the surface of the air than a horse can trot.

For sixteen years Mr. Langley has steadily pursued his work upon it. Engrossed, as he has been, first in astronomical investigation and later in administering the greatest of our scientific insitutions, he has had only leisure moments to devote to it, and now, after thousands of experiments and hundreds upon hundreds of failures, he has accomplished what scientists once declared to be impossible. Knowing that his work was done almost at the risk of his scientific reputation being questioned, during the early years of it he kept the object of his investigations to himself. To-day the world knows practically nothing of them, and it was only last May, after persistent urging on the part of his friend, Professor Alexander Graham Bell, that he allowed him to state the fact that he had succeeded.

Since then additional improvements have been made. A new and better machine than that which flew a half mile in May last has been tested. It has made a more successful flight, and to-day Mr. Langley permits me to give in my own words the first full description of his success to the public. I have spent several days with him upon the island in the Potomac River, about 30 miles below Washington, where his last experiments have been conducted, and on Saturday, November 28, I witnessed the most successful flight which has yet been made. I saw this machine, made chiefly of steel, weighing as much as a four-year-old boy, yet so large that it would just about fill the average parlour, moved by a steam engine which was a part of it, dart forth from the launching stage and fly in an almost straight line through the air a distance of more than 1500 yards, or over three-quarters of a mile. It flew almost as far as the length of Pennsylvania Avenue, between the Treasury and the Capitol. The flight was horizontal. There was not a quiver of the wings, and the great bird-like aerodrome swam, as it were, upon the planes of the atmosphere. It flew first to the right, across the bay toward a strip of woods, and, as Mr. Langley and myself watched it, our hearts for the moment came into our throats, for it seemed as though it would dash itself against the trees. As it neared them, however, it gracefully swept round and downward, then turned and rose, and as straight as an arrow flew across the bay where we were standing on towards Washington. It continued to fly in this straight horizontal line until the water which furnished the steam was exhausted, when it slowly but gracefully swept down and rested upon the water It lighted so gently that not a bit of its machinery was injured, and had it not been that the evening shades were falling it could have been flown again. I have never seen any inanimate thing look so like a thing of life.

It was as graceful as any bird, and as it swam through the air, its propellers, which were going about at the rate of over a thousand revolutions a minute, made a whirring noise like the wings of a bird in rapid flight. The feathery smoke of the engine could be seen wreathing its way out of the smoke stack, and, as the setting sun caught its silken wings, and the white, silvery substance which bound the body containing its machinery, it seemed like a wonderful new species of bird. The great danger of losing the machine in the trees led Mr. Langley to put only enough water in it to allow it to fly about one and one-half minute. It could have carried water for about five minutes, but as it was, it flew, by two independent stop watches, one minute and forty-five seconds, being the only flight of any aerial machine except itself which has ever lasted for more than a very few seconds. In this minute and three-quarters it flew a distance of almost a mile, going at the rate of over thirty miles an hour, and showing that if it had been fully supplied with water, it would have flown for more than two miles. As it was, its flight was only limited by the exhaustion of its steam, and there seemed no reason but that with more steam to run it, it might not have gone on indefinitely. With a machine ten times its weight, Mr. Langley told me, a condensing apparatus could be carried upon it, which could use the water over and over again, and the same amount of water would carry it for hundreds of times its present flight. The machine flew against the wind. There was nothing of the balloon nature about it. There were no gas bags to uphold it. Its wings were immovable, and they merely steadied it as it flew like a bird through the air. The force which carried it onward was generated upon it.

As I looked at it I could hardly realize the remarkable thing which Mr. Langley has accomplished. Let me repeat it.

The aerodrome is a machine made almost altogether of steel. A balloon floats because it is lighter than the air. This machine weighs more than one thousand times as much as the air through which it moves. The working parts of its machinery are of steel, and it carries a peculiar steam engine which forces it along through the air. In constructing this machine the question of weight was an all-important one, and everything had to be reduced to the minimum. The aerodrome, weighing less than thirty pounds, carries about four pounds of water. This is about two quarts, and the little engine is so wasteful of it that its flight must be proportionately short, for when the water has been once converted into steam the aerodrome must stop flying, as there is no more water to furnish steam to run it. The machinery of the air-runner is very light indeed, but it requires a considerable force to move it in proportion to its weight. Its engine is equal to more than one horse power and the movable parts of the machinery weigh twenty-six ounces. You could put all of its machinery into a peck measure. Now, a horse weighs a thousand pounds. Think of reducing the size of a horse to a peck measure, and its weight to that of a kitten, and you have some idea of Mr. Langley's aerial engine.

What does the aerodrome look like?

Digitized by Google

I have described it in flight. I examined it at rest, and I have gone carefully over its different parts. It is about fifteen feet long, and about fourteen feet wide from the tip of one wing to the other. The machine moves through the air on much the same principle as that by which the twin-screw steamer forces its way through the water. On each side of the aerodrome there is a sort of screw propeller or pair of blades in the shape of one cutting of a screw so hung upon a pivot that when the steam is on they fly round at the rate of a thousand revolutions a minute. They look, in fact, much like the wheels of an electric fan when in action. They cut the air so rapidly that you cannot see the blades, and they are, in fact, a pair of wheels about four feet in diameter, flying at this wonderful speed around through the air. As they move they screw the air ship onward, and this advancing motion keeps it up in somewhat the same way that a swift skater can be supported by thin ice.

The machinery is in a metal receptacle which ends in a smoke stack. This is hung to a frame work of steel. The wings, which are stationary, are fastened to the upper part of the framework, and they extend far above the body holding the machinery.

The machinery is wonderfully delicate, but it is as strong and at the same time as light as scientific investigation can make it. The fuel is gasoline, which is converted into gas before it is used, and which furnishes such an intense heat that it would melt the boiler in a second if there were not a special pump by which the water is kept flowing rapidly through the boiler, the intense heat converting some of the water into steam as it flows. Every part of the machinery is of the most practical nature, and it has been constructed at an enormous expense of patience and experiment. It may be said that nearly every atom of the aerodrome as it is now put together is the result of experiment. The making of the boiler alone consumed months of work. Every bit of the machinery had to be constructed with scientific accuracy. It had to be tested again and again. The difficulty of getting the machine light enough was such that every part of it had to be remade several times. It would be in full working order, when something would give way, and this part would have to be strengthened. This caused additional weight, and necessitated the cutting off of that much weight from some other part of the machinery. At times the difficulty seemed almost heartbreaking, but Mr. Langley went on piece by piece and atom by atom, until he at last succeeded in getting all the parts of the right strength and proportions. Even after he had completed his model, and had it ready for flight, he was confronted with an unexpected difficulty, which was, it seemed at the time, almost impossible to surmount.

This was the launching of the machine into the air. One of the most difficult things that large soaring birds have to contend with in flying is in getting a start. You know how difficult it is to launch a ship into the water. It is far more difficult to launch an air ship. Mr. Langley found that his machine had to be clamped down on the launching stage, and to be arranged in such a way that the machinery could be started, so that it should receive a slight initial velocity and then be released with a spring. This looks easy. It was hard. But Mr. Langley at last succeeded in launching his machine by hanging it to a movable table, so that it could be turned to face the direction in which the flight was to be made, and so that the wheels of the table would carry the aerodrome straight out in a horizontal line and launch it off into the air. The launching apparatus which we used on November 28 was built on the top of a houseboat, and the work of arranging the table was no small one. As I stood upon it and examined its construction Mr. Langley said: "It doesn't seem to be much, but it is the result of five years of experiments."

I here asked Mr. Langley what first attracted his attention to aerial navigation.

"I can't tell when I was not interested in it," he replied. "I used to watch the birds flying when I was a boy, and to wonder what kept them up. I afterward heard the theory that they possessed great muscular power. You know some scientific men have stated their belief that the muscular strength of birds must be enormously greater in proportion than that of men. But this it seemed to me could not be true. I could not believe what some French mathematicians calculated, namely, that an eagle must be nearly as strong as a man. It finally occurred to me that there must be something in the condition of the air which the soaring birds instinctively understood, but which we do not. This idea I held for a long time, the flight of birds continuing to be a wonder to me. It is curious how an idea of that kind sticks to you. I seldom saw a bird flying that I did not think of it, and even lately I have watched them for hours, trying to understand how they could move about through the air, rising and falling, soaring up and sailing down without any motion of the wings."

"But, Mr. Langley, I thought that birds used a great deal of strength to fly. They can't fly without moving their wings, can they?"

"The soaring birds can," replied Mr. Langley, "and they do fly long distances with apparently very little exertion. Darwin once watched the South American condors, which, you know, are immense birds, for hours. He says they ascended and descended, soared and circled about, with scarcely the movement of a feather. He could not detect a single flap of their wings.

"I remember," continued Mr. Langley, "how I stood, one cold November day, on the aqueduct bridge that crosses the Potomac River above Georgetown, and watched a turkey buzzard which was lazily soaring round and round, watching something in the river below. The wind was blowing a gale. It was going at the rate of at least thirty-five miles an hour. Still the bird moved about with the greatest ease, keeping generally on one level, but swaying a little as it went round and round. It was not more than sixty feet above me. I could see it perfectly, and could not note the flapping of a wing, though I watched it for a long time. I stayed, in fact, until I got so cold that I had to leave.

"I remember well when I began to experiment to see if my supposition was correct. It was after a meeting of a scientific association, in which someone stated that an inanimat-

thing could, under certain circumstances, be made to move in the air against the wind by the power of the opposing wind itself. He claimed that he had made experiments proving this fact, and he stated as an evidence of the truth of his theory that he had seen birds not only come close to the earth and hang stationary in the air, but even advance against the wind and ascend in the air without flapping their wings. He was laughed at, but it is now conceded that what he claimed is not theoretically impossible. I, myself, did not believe he was right at the time, but it set me thinking. My old interest in the subject revived, and I began at once to make experiments. I wanted to know the actual facts as to the power needed for flight, and how it was possible that bodies heavier than the air they displaced could keep themselves in the air without falling. I did discover that there was no doubt but that a machine could be made which could support bodies in the air, and which would carry them forward. I have shown you here to-day a machine which will do this. I have proved that we have the power, and the only question now is to learn how to direct and control it.

"My first experiments were made when I was connected with the astronomical observatory in Pittsburg. It is now more than fifteen years ago that I built my first laboratory for aerial investigation there. A friend of mine, Mr. William Thaw, a wealthy citizen of Pittsburg, supplied the means, and I was enabled to make all sorts of tests to ascertain the power used in aerial motion. One device which I had was a whirling table. This was an arm about thirty feet long, which swung about on a central pivot, ten feet above the ground. It was moved by a ten horse power steam engine, and it went flying around, moving at all speeds up to seventy miles an hour. Now, on the end of the arm I put instruments which would measure the lifting power of the wind upon any inclined surface hung to them. I had, for instance, a spring scale hung there, and to this brass plates were attached. When the arm was put in motion I found that the faster it went the less weight the plates registered on the scales, until at great speed they almost floated in the air. I found, in fact, that the higher the speed the less was the force required to keep the plates from falling. This seems at first a contradiction of known principles, but I have no time now to explain it. I found that not one-twentieth of the force before supposed to be required to support bodies under such conditions was needed, and what before had seemed impossible began to look possible.

"This means that I found," continued Mr. Langley, "that an entirely wrong estimate had been made as to the force needed to sustain moving bodies in the air. Some mathematicians, reasoning from false data, had concluded that if it took a certain amount of power to keep a thing from falling, it would take much additional power to make it advance. My experiments showed just the reverse. I found that it took much less force to push a body rapidly through the air than was needed to simply sustain it there. I found, in short, that the conditions of air travel with my planes and of land and sea travel were in one important respect the opposites of one another. An ocean steamer running at twenty knots an hour will take several times as much coal as is required to run it at the rate of ten knots an hour. The limited express uses a great deal more coal than the slow freight for the same weight and distance. This is not so in aerial flight with planes. Actual experiment shows, I repeat, that the faster the speed the less the force required to sustain the planes, and that it would cost less to transport such planes through the air at a high rate of speed than at a low one. I found further that one horse power could carry brass plates weighing 200 pounds at the rate of more than forty miles an hour in horizontal flight. Everything, however, depended upon the flight being strictly horizontal. I found that if it were the least irregular the power must be increased in proportion to the irregularity."

"It was interesting, but so far it had been conducive to no practical results. I had been working now for years, seeking to learn the principles involved in flight. I thought I discovered some of them. The question was how to apply them. The field, you know, was entirely new. I had to make, and to a large extent invent, the machinery I used. My experiments showed me that I must have a very light engine; but they did not tell me how to get it. They did not show me how to keep the flight horizontal, nor did they give me any idea how such a machine as I might construct could be made to start and alight in safety. There were a number of other things which I should have liked to know, and some of which I still hoped to learn which were entirely in the dark. As the result of my work I had some extremely important and valuable facts, but my experiments so far had not told me how to apply those facts to the making of machines for flying. I had only the conviction that what had hitherto been an impossible fancy might in the future become a mechanical fact. I could see, at any rate, from what I had learned, that the subject was worth a new and scientific investigation.

"I next began a very different kind of experiments. The average man might have looked upon my next work as somewhat childish. I spent many hours in experimenting upon little toys, which I tried to make actually fly. I had my facts, you know, and I wanted to see how they would work out in actual practice. The only thing that had yet been done in making toys or anything that would fly was by an ingenious Frenchman, named Penaud, who a decade or more ago had made a flying toy by twisting strands of rubber, which in untwisting turned a little propeller wheel made of a couple of feathers. The propellers moved the toy forward. They kept it in the air for a number of seconds, enabling it to fly from fifty to one hundred feet. Simple as this toy looked, it was the father of a future flying machine, and France ought to have the credit of it. I tried the same thing again and again on a larger scale, my object being to learn what the conditions were by which we could secure a horizontal flight in free air.

"I did not find out a great deal. The rubber models flew so irregularly and for so short a time that I could not learn much from them. I soon saw that I must have a better motive power. I must have something that would make a machine fly long enough for men to observe how it flew. In other words, in order

Digitized by Google

to learn how to make a flying machine, I must have a flying machine to begin with.

"I examined and experimented on every kind of a motor. I tried compressed air, carbonic acid gas, the storage battery, the primary battery, and many other things, including the gas engine. The last was the most promising, and it may some day prove to be the best; but, like everything else, I found it too heavy, for you see the engine had to be exceedingly light in proportion to the power. After much experiment of this kind, I concluded that the only immediate hope was in the steam engine, and that it could only be used provided it could be built to a degree of lightness which had hitherto never been attained. I had to have nearly one horse power to give me a good chance for any practical experiment. Now, it is only a few years since an engine developing this amount of power weighed as much as a horse himself. In other words, it weighed something like 1000 pounds. I had to have a one horse power engine and boiler which together would weigh less than ten pounds, or one-hundredth the weight of a horse, and I at once went to work to make it. It took me a year to construct it, and I had the best of mechanics to help me. I reduced the weight atom by atom, building and rebuilding, until now I have what I believe to be the smallest one horse power engine in the world. Its moving parts, as I told you, weigh just twenty-six ounces, or less than two pounds. As it was with the engine, so it has been with every part of the machine. Every part of it has had to be made over and over again, until, as a result of the greater part of my leisure for the past fifteen years, I have accomplished what you have seen to-day.

"Yes, I have succeeded. I have proved both theoretically and practically that machines can be made which will travel through the air. The question of the development of the fact is one of the future. My motive and interest in the work up to this time have been purely scientific ones, but if I had the time and money to spend upon the construction of a large machine, I believe I could make one on a scale that a large passenger-carrying flying machine can be a commercial as well as a scientific success. There are many things yet to be learned concerning it, but I have no doubt they will be discovered in the future. The moment that men see that such machines are not only practicable, but that they may be made commercially profitable, there will be a thousand inventors working upon the problem where there is now one. I believe, however, that the flying machine will first come into national use in the arts of war rather than those of peace. In the event of a great war, by means of an aerial machine the armies of one nation will be able to know exactly what those of the enemy are doing, thus radically changing present military strategy and tactics, to say nothing of their power of dropping down bombs out of the sky. I believe, however, that such inventions will finally be of even greater advantage in the arts of peace. I have faith that the swiftest and perhaps the most luxurious, if not the safest, travelling in the future may be through the air."

"But will it not be impossible to induce people to risk their lives in the first experiments on such machines?"

"I think not," replied Mr. Langley. "If I had a large aerodrome constructed on the principles of the one you have seen to-day, though the danger of the initial experiment would undoubtedly be great, I am sure I should have to turn away any number of men who would be anxious to risk a flight upon it."

The Late Mr. F. W. Brearey.

While the world is waiting for the new developments which seem to broaden out in contemplation of the command of the atmosphere by man, so that he may be free to traverse it in every direction, we would remind those who would give honour where honour is due, not only to offer praise to the successful inventor, but also to those whose pioneering exertions have led to eventual success—for such it must be regarded. Prominent among these in our own country is the name of Frederick William Brearey, who seems very early in life to have been a dreamer of aerial dreams.

It may account for these youthful aspirations that his father was a friend of the late Sir George Cayley, of Stillingfleet, near Scarborough, the latter being the place of his birth in 1816. His father and sister were occasionally the witnesses of the experiments in flight made by the scientific baronet, and although Mr. Fred. Brearey does not remember any influence upon his mind resulting from overheard conversation, yet the idea seems possible. Although he says he remembers seeing Sir George at York, he never heard of his aerial experiments until after he arrived at manhood, and only then from his sister. Sir George Cayley's papers and experiments, published in the "Mechanic's Magazine" of that period, have since become to him and other students of aeronautics a storehouse of knowledge.

The time came when Mr. Brearey's aerial dreams began to take shape, but not until the year 1865 did he make any progress.

In the January of the next year the Aeronautical Society of Great Britain was launched from the House of the Duke of Argyll at Campden Hill. A nobleman of such acknowledged scientific attainments becoming President of the Society somewhat abated the ridicule of Mr. Brearey's friends, but it has accompanied him more or less as each attempt was reported a failure.

As soon as it became known that the Society was formed in Great Britain, there came plans and suggestions from all parts of the civilized world, with applications for the money which it was supposed that John Bull was anxious to lavish upon inventors, and from that time until now, nearly thirty years, the copies of letters, all in the handwriting of Mr. Brearey, and the letters received, testify to the gratuitous labours of the Honorary Secretary. The Société Française de Navigation Aérienne soon

voted him their gold medal, and, as showing the effect which his papers, read at the meetings held at the Society of Arts, and magazine and newspaper articles, for the most part reprinted in other countries, had upon scientific minds, one of several letters spontaneously addressed to him will suffice. It was from the then President of the American Society of Civil Engineers, Mr. O. Chanute, dated from New York, February 3rd, 1882:—"We are in this country aware of your long-continued experiments and efforts to promote a solution of the problem of aerial navigation, and know that it is through your influence that the subject has been cleared of much rubbish, and placed upon a scientific and firm basis."

It was soon accepted by Mr. Brearey as conviction, that aerial navigation could never be accomplished by balloons, however useful they might be in their own sphere, so that all his attention and experiments were directed to the mechanical means of attaining it. These were so suggestive and encouraging that in a lecture room he was able to show various forms of sustained flight over the heads of the audience, and although he has lectured in more than fifty cities and towns in England and Scotland, and liberated models of two or three pounds' weight, with a spread of wing of 12½ ft., he never caused an accident which created anything but amusement. Not so a lecturer at the Royal Polytechnic who, lecturing there upon the flight of one of Mr. Brearey's models, apologised for the absence of it upon one occasion "because the model had flown at a lady and the lady flew at him." The action of these models, of which he used to show more than thirty in his lectures, was very precarious, but occasionally their flight would surprise him. At Plymouth, for instance, one wing-flapped bird flew twice round the room, and returned to his hand on the platform, as if directed. At Truro, in a very large hall, a screw-propelled plane flew to the end of the hall, and, without touching the wall, turned round and got fixed on the gas fittings on the platform. At the Hartley Institute, Southampton, he liberated from his hand the model of an albatross, with wings of 12½ ft. in width, made of very slender material, both as to the shaft of the wing and the covering; so slender, indeed, that in holding it out ready for flight, the wings dropped on each side of him, so that no one would have thought flight possible, but the moment that action was imparted to those drooping wings, they stiffened out, and through the reflex action at the tip of the wing which effects propulsion, the model flew the whole length of the room, about 2 ft. above the heads of the audience, and, although rising at the end, just managed to clear the gallery. This was repeated with like result, in obedience to continued applause. With screw propelled planes he was equally successful, and it is on record how he suggested to Captain (now Lieut.-Colonel) Templer the means of sending information to a distance from a balloon. Mr. Brearey having supplied the apparatus of simple construction, Capt. Templer liberated it from a height, when it travelled back to Woolwich Arsenal against the wind, which carried away the balloon. Thus was conveyed a dead weight, the prerunner of the live weight conveyed in like manner by Herr Lilienthal's machine near Berlin—at that time a member of the Society. This successful experiment was recorded in the "Daily Telegraph," October 10th, 1879, and "Daily News," October 21st.

As Mr. Brearey has written a work, "The Atmosphere as a Medium of Travel," which awaits a publisher, I must abstain from much that I should like to chronicle, but I cannot forbear giving a few anecdotes. One of his correspondents, advocating the propulsion of balloons, thinks that it may be accomplished thus: He would surround the balloon with compartments in which hawks can be located, confined by attachments to little leather breeches. When it is desired to propel the balloon, the aeronaut yells, and the hawks, liberated in this frightened manner, will lighten the balloon so that it will rise.

He even believes that they may be trained to pull altogether, and so hawk the balloon about the country. Another correspondent who, being an engineer, was supposed to understand the supporting power of surfaces when launched into the air from a height, seriously proposed the erection of towers at distances suitable to the effective gliding transmission of the surface. The passengers were to place themselves under this surface, and glide downwards to the next tower.

A lift would take them to the top while the apparatus would be hauled up for their reception, and away they would float off to the next tower, and so on, and so on.

These are a sample of some of the wild schemes of enthusiasts. Mr. Brearey has upon several occasions lost blood in the cause, and copiously, too, at the Alexandra Palace, when a screw-blade, revolving at a great velocity, produced by the great muscular effort he was exerting in turning a handle, flew off, and hitting him in the face, cut a portion of his nose off, at the same time cutting open his cheek. The nose was cleverly sewn on, but the after effect resulted in an operation by which the eye was barely saved. Again, when returning from the Crystal Palace, where for many days he had been in attendance, witnessing some interesting experiments in plane propulsion, a railway accident produced concussion of the brain, and confined him to his bed for many weeks. It was in connection with these experiments that the following ridiculous incident is related. Mr. Brearey had made an appointment to meet the Duke of Argyll, the late Duke of Sutherland, and the Earl of Dufferin. After they had spent some time in examining the steam-driven apparatus, said he, "We proceeded to the lower level exit to catch the train. On passing the cloak room the Earl started from us, saying he would be back directly, as he had left his coat there.

Digitized by Google

On attempting to pass the barrier, the ticket collector exclaimed to the Earl, who had the coat over his arm, "Holloa, where did you get that coat." The Earl was unaware that a ticket was attached to the coat, which had caught the inspector's attention, and caused him to look with suspicion upon the whole party. "Yes," said the Earl innocently, "there was no one in the cloak room, so I took it."

This was too much for the inspector, who, casting a glance at us, said in an authoritative tone, "Has anyone else boned a coat?"

"Come with me," said the Duke of Argyll to the Earl. "What does he mean by boned?"

"Stole it," says the Earl.

As we reached the cloak room the attendant, who had left it for a short time, was just entering the room, thus confirming the Earl's statement. Of course, this was quite satisfactory. "But," says Mr. Brearey, "I shall not easily forget my indignation at the man's manner, nor my admiration at the suppression of any anger which must have been felt by the party. After they had departed, I could not avoid saying to the inspector, "Do you know who that gentleman was that you accused of stealing a coat?"

"I neither know nor care," said the man carelessly.

"Well," I said, "he was the Earl of Dufferin, Governor-General of Canada; the taller of the two others was the Duke of Sutherland, and the other was the Duke of Argyll."

"Good God!" said the man, "you don't say so?"

With respect to the ultimate issue of the late plane propelled experiments, Mr. Brearey, who—at least, theoretically—became possessed of as much knowledge as anyone in this kingdom, said that there were two systems by which success has been ascertained to be certain, so far as ascent is securable by mechanical means alone, viz., Maxim's and Phillip's. The former answers to the prognostication of the Duke of Argyll, expressed when presiding over the first meeting of the Society in 1866.

"I think it quite certain that, if the air is ever to be navigated, it will not be by individual men flying; but that it is quite possible vessels may be invented which will carry a number of men, and the motive force of which will not be muscular action."

Mr. Maxim says that it is only for such dire purposes as war that his inventive genius has aimed at. This means heavy weights. Phillip's will come within the capacity of the pleasure seeker. Both have yet to come under control when set free in the air. Both inventors are members of the Society.

"Then," said Mr. Brearey, "will come the real test, and the real danger, but, that success will be ultimately attained, who that considers man's pluck, luck, and perseverance can doubt."

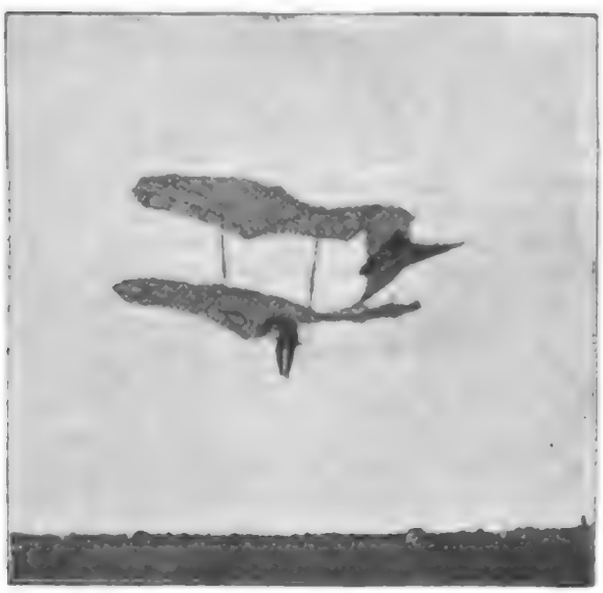
On January 31st, 1896, Frederick William Brearey suddenly and peacefully passed away.

The Death of Lilienthal.

There can be no doubt that we learn as much from failures as from successes, and it is a pity that fruitless efforts are not more often put on record. How frequently it must occur in scientific investigations that a man works away upon some idea that occurs to him, when that same idea has occurred to hundreds of others before him who have also worked at it in the vain hope of attaining the desired end. A long register of failures may be uninteresting reading, but it may be very useful, especially when a full and clear reason is given for each failure. All students of aerial navigation have been interested in the accounts of the experiments of Herr Lilienthal, near Berlin. Everyone owned that, whether or not he was on the real road to the unravelling of the mysteries of flight, yet his experiences were of the greatest importance. He himself said, "this danger can only be avoided by becoming acquainted with the wind by constant and regular practice," and later, "I myself have made thousands of experiments within the last 5 years, and have had no accidents whatever." It is very shocking, then, to hear one day that this bold experimenter was killed during one of his flights. He is bewailed as a martyr to science. People then asked "what happened?" and the answer is generally given that he lost his balance and fell, and there is an end of it. But this is not sufficient. It is most important for us to know how it was that Lilienthal, after all his practice and experience, came to grief. We will quote such accounts as have been published. The "Daily News" correspondent telegraphs: "He started with a machine from a hill about 100 ft. high, and at first all went well. After remaining in the air for a few minutes, however, the machinery got out of order, or according to another account, a sudden gust of wind caught the machine, and the unhappy man fell heavily to the ground." Now those who know this simple apparatus will ask what part of the "machinery" could get "out of order?" And as for the sudden gust of wind, it was just these gusts that the poor experimenter had been practising to combat for five years past. The next account we have reads: "Suddenly something went wrong with the machinery, the wings ceased to act, and he fell." Here again it is difficult to know how the wings, consisting of a rigid plane, could "cease to act." Another account says: "The apparatus lost its balance," and, "the details of the accident seem to show that the conduct of the parachute, for such it really was, was very nearly that predicted, for the machine turned several somersaults." Another commentator says:—"Any such apparatus which exposes large surfaces to the atmosphere is at the mercy of a sudden gust of wind, with the result that its equilibrium is destroyed, and the whole machine is overthrown and tumbles to earth." Now any careful experimenter knows that an apparatus can be made

that will always be stable. Make a model of Lilienthal's machine, attach a heavy weight to it in the position of the man, and throw it about how you will in the air, it will always come down "cat-like" on its legs. No! we must look further afield to get at the real cause.

This machine, as is well known, consisted of an upper aeroplane, placed over the lower wing-like structure around the man. A correspondent writing to "Nature" says: "These two-storey models soared in the most astonishing manner, . . . and never showed the slightest tendency to take 'headers.'" They "would also show a greater stability, a result all the more to be expected, as the centre of gravity of the system was placed more than a metre below the upper surface." This correspondent quotes the mechanic who, not unfortunately, was the only person to actually witness the disaster. "The man saw him soar down until he was nearly above the foot of the hill; then suddenly a gust of wind set in, lifted him up to a height of 30 m. above the ground—according to his man's estimate—and then he stood apparently motionless in the air. This was a frequent occurrence, and gave no cause for alarm at first; but now the man saw how Lilienthal gradually lowered the fore-edge of his wings more and more, without obtaining the



[From the *Golden Penny*

desired effect of getting way forward and downward. . . Suddenly he saw the apparatus heeling over forward still more, and then Lilienthal came down with it with great force, head foremost. When the man reached the spot he found the apparatus much shattered."

Though it is thus rather difficult to get at the exact account of this unfortunate occurrence, it is most probable that the machine tipped *forward* slowly and fell. But now, as has been said, a model of this two-storied plane will not act like this. On looking at a photograph of the apparatus, what at once strikes one is the extraordinarily delicate and flimsy connection there is between the two planes. Indeed, it is difficult to realize how the apparatus could be rigidly constructed. There are apparently two light upright rods connecting the aeroplanes; nothing more is visible, though presumably these are stayed with wire. But if extra pressure is brought on the front edge of the upper plane, what is to prevent its being forced back? Suppose for a moment it was forced back.

Would not the whole apparatus at once pitch forward? The centre of gravity would come well in front of the centre of area, and nothing would prevent the machine taking a "header" to the ground, even, perhaps, making a somersault. The more one looks at the photographs, the more one wonders at the weak-looking connection of these aeroplanes, the more one sees how easily a slight mishap might cause the upper plane to shift back.

But there are other conjectures as to the cause of the accident. Mr. Pilcher, who has had great experience in England with an apparatus of very similar construction, remarked, on first hearing of Lilienthal's new double plane, that he did not like the looks of it, as he had found that if the man's weight was too far below the supporting surface, there was great difficulty in controlling and managing



[From the *Golden Penny*.

the apparatus. There is also another cause, which is believed by those best acquainted with the circumstances, including Herr Lilienthal's brother, to account for the accident. In this fatal trial the inventor had adopted a method by which he could alter the position of the horizontal tail by a movement of his head. It is suggested that, not being practised with this appliance, he may have made some wrong movement of his head, which unexpectedly upset the balance. This certainly seems as if it might have been the cause of the accident, except that the eye-witness describes the

Digitized by Google

pitching forward to have taken place slowly, and, if so, one would have expected the experimenter to have rectified his error in time.

Unfortunately the apparatus was completely smashed up, and beyond the fact that it was found lying upside down, gives no clue to the cause of the unfortunate mishap.

Captain Moedebeck, one of the best authorities in Germany, conjectures that in shifting the weight of his body, as he was accustomed to do, Lilienthal forgot about the apparatus connected to his head, and so counteracted the balance by the action of the tail.

Though we are, then, unable to account with certainty for the unfortunate mishap, we may at all events avoid in future accidents the causes of which are here suggested.

Dr. Wolferts' Steerable Balloon.

This elliptical-shaped balloon was shown in working order at the Berlin Industrial Exhibition last year, and was said to have acted very satisfactorily. It is provided with two screw propellers; one, about 9 feet diameter, placed in front of the car, is to propel the balloon horizontally, while another is placed underneath on a vertical axis to control the rise and fall. The engine is of 8 horse-power, giving 500 revolutions per minute to the propellers. The balloon is nearly 100 ft. long and 30 ft. through the centre.

Speed of Flying Birds.

To measure the exact velocity of birds in flight is no easy matter. Homing pigeons give a reliable record of the average rate of travel over long distances, but it may reasonably be presumed that this speed is not the maximum obtained, or even an average rate for steady flight, since the course would often not be in a straight line, and the speed affected by variable winds and other causes. Mr. S. P. Fergusson, however, made some careful measurements a short time since on a flock of ducks which happened to pass whilst he was engaged in measuring cloud velocities at the Blue Hill Meteorological Observatory. The result of these trigonometrical observations was that the birds were found to be moving at a height of 958 ft. above the ground, and that the velocity of their flight was 47.8 miles an hour. The wind at the time was light from the north, the direction of flight being from the north-east.

Summary of News.

Stentzel's Wing Machine. — A flying machine, similar in many respects to those of the late Herr Lilienthal and Mr. Pilcher, has lately been experimented with at Altona, Germany. It possesses, however, one great point of difference from its predecessors in that the wings are pivoted so that they may be moved up and down as with those of a bird. The wings have a spread of about 21 ft., having a surface of about 76 square feet, and may be moved through an angle of 70 degs. The apparatus weighs 75 lbs. An engine, worked by compressed carbonic acid gas, is to be used for working the wings. It is stated that this engine, with a pressure of 5 atmospheres, is capable of producing 1 horse power, and that by increasing the pressure to seven or nine atmospheres, the motor may be made to yield 2 or 3 horse power respectively. The wings, in shape, are not so round as those of Lilienthal, but are pointed towards the tips like a gull's. The tail or rudder consists of both horizontal and vertical planes.

Dr. Richet's Machine.—It is announced that a large apparatus, chiefly consisting of two huge wings, is now being constructed in France. The inventor is Dr. Richet, a professor in the Faculty of Medicine at Toulon.

Kites for Meteorology.—During last year a great deal has been done in America with regard to meteorological tests of the upper air by means of kites. Mr. Fergusson, of the Blue Hills Observatory, has written an interesting account in the "Monthly Weather Review" for September, of experiments conducted at that institution. The kites used were usually of the Malay pattern for light weather, and of the Hargrave type in strong winds. Self registering instruments were taken up by the kites, and some very great altitudes were attained, the highest being no less than 9,375 ft.

Andree's Arctic Balloon.—M. Andreé has stated that he intends making a fresh start this summer to explore the Arctic regions with his balloon. In addition to the continual adverse winds last year, he found that the balloon did not retain its gas quite so well as was expected, and doubtless before he starts again he will consider it necessary to add another covering, or, at all events, some fresh coats of varnish, to the envelope.

Chanute's Experiments.—Although some sensational rumours have been published with regard to the trials of a flying machine on the shores of Lake Michigan, we have the best authority for stating that these have been simply some scientific experiments in gliding flight, which have so far produced no very important results. Mr. Chanute's name is a sufficient guarantee that they will be interesting from a scientific point of view, even though not intended to be a practical success. He has been assisted by Messrs. Paul and Herring.

Recent Patents.

The following patents connected with Aeronautics were published during 1896 :—

1877. Jan. 22, 1896. T. Fraser, Victoria, Australia. Improvements in Dirigible Balloons and Flying Machines.

Elongated buoyant vessel, constructed of metal sheets, in separate compartments; motive power, compressed gas, which also is used as ballast.

9129. R. Kosch, Cleveland, Ohio, U.S. A combined Screw Propeller and Aeroplane, for raising, lowering, and sustaining Air Ships.

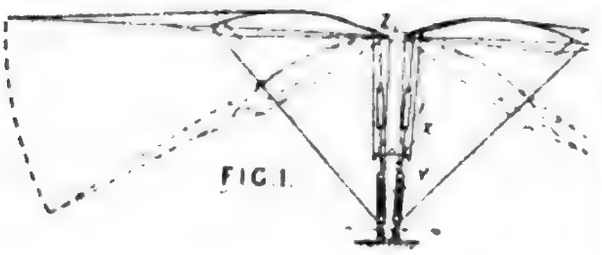
Having adjustable blades which can be set so as t lie in the same plane or parallel planes.

18,130. Aug. 15, 1896. W. C. Sly, Brockley, Kent. Improvements relating to Parachutes.

Series of air-tight tubes arranged about the parachute, which when inflated with air form a stiff frame for mechanically expanding the parachute.

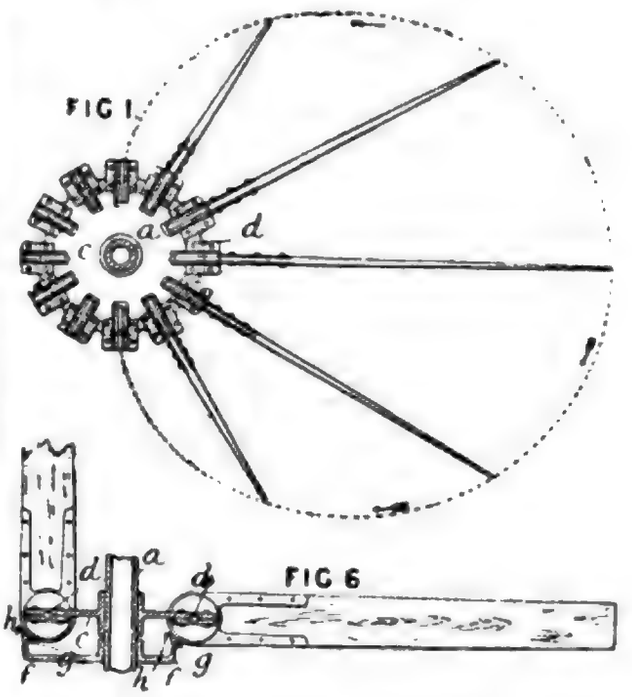
(From the *Illustrated Official Journal.*)

6. January 1, 1895. Aerial Machine. Moore, R. F., 39, Brigstock Road, Thornton Heath, Surrey.



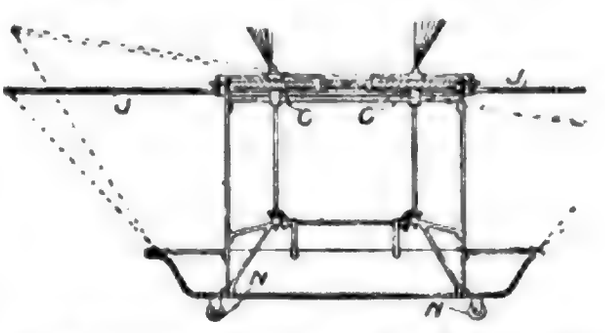
Propulsion is effected by means of wings made in imitation of those of the flying fox; they are composed of a light framework and covered by fabric and are hinged to the framing at Z. They are also attached to the lower end of the framing by springs Y, which are adjusted to hold the wings in position when they are supporting the machine. Lines are attached to the extremities of the framework of the wings and to the lower end of the machine so that the wings may not fail to act as a parachute in case of accident. The machine rests on wheels when on the ground, and the wheels may be adjusted so that it can run down an incline at starting. The wings may be actuated directly, as shown at X, or by an electromotor comprising two or four electromagnets in line, that alternately attract and repel each other. Each magnet comprises an iron core around which the wire is wound and an iron cylinder surrounding the wire. The magnets carry mercury cups and needles which make and break circuits in small electromagnets on the commutator causing an armature to oscillate between them and move pins on its lever in and out of mercury cups which are connected with the motor circuits.

4025. February 25, 1895. Aerial Propeller. Martin, L., Klausenburg, Hungary.



The propeller comprises a feathering wheel shown in elevation in Fig. 1 and in plan in Fig. 6. The blades are pivoted at *d* to a revolving boss *c* and carry angle irons *g*, *h*, which ride on a cam *f* and shift the blades from the right hand position, in which they make their down stroke, to the left hand position, in which they lie parallel to the shaft *a* for making the upstroke.

7271. April 9, 1895. Aerial Machine. Olivas, E. C. de los, 34, West 15th Street, New York, U S.A.



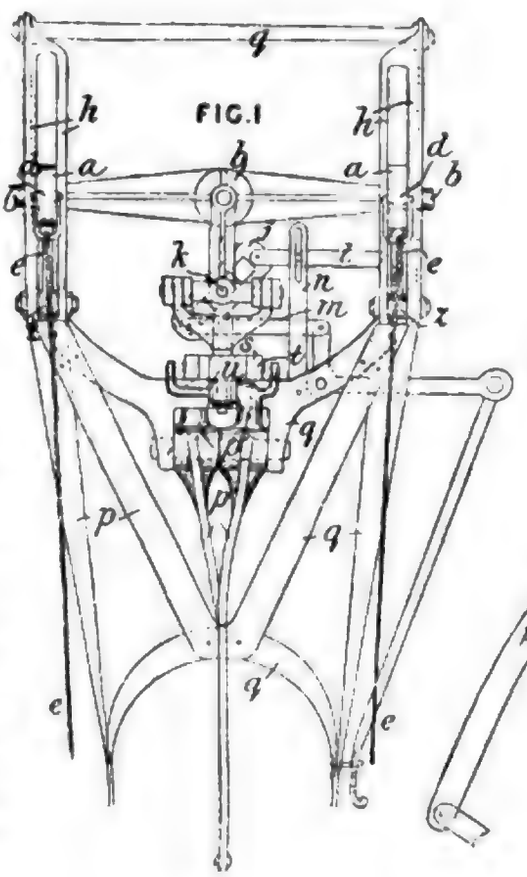
The machine is raised and propelled by two

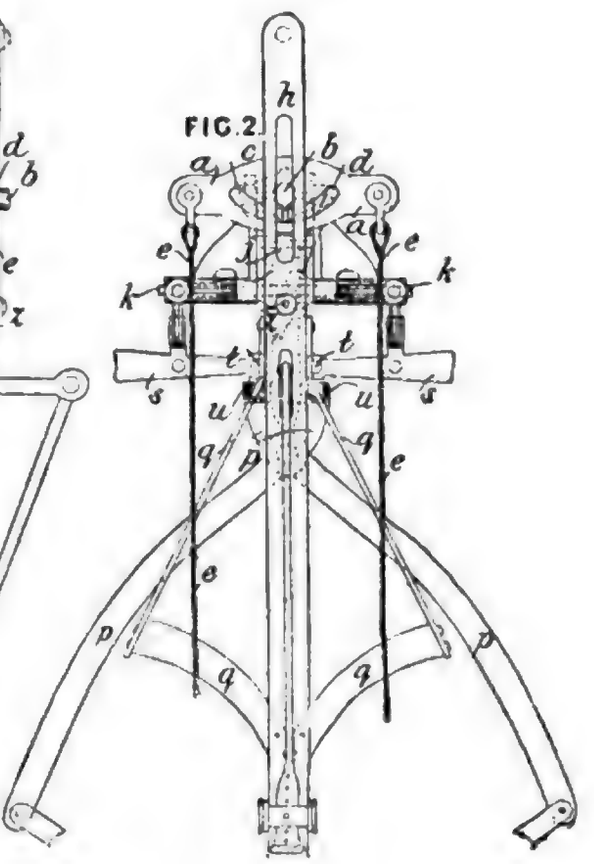
Digitized by Google

propellers C revolving on vertical axes, and its direction of motion is controlled by an aeroplane J which is mounted on a universal joint. The buoyancy of the machine may be increased by an aerostat. The car is fitted with spring rollers N to deaden the shock of landing.

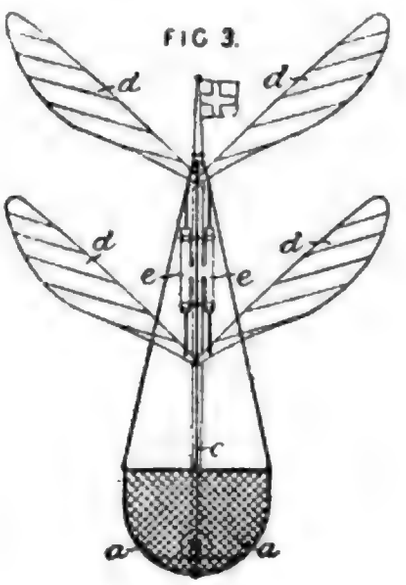
4125. February 26, 1895. **Flying Apparatus.** MACDONALD, T., Monument Buildings' Monument Square, London.

The apparatus, of which Fig. 1 is a side and Fig. 2 a front view, is strapped by means of a frame *q* on to the shoulders of an aeronaut, while the wing-arms *s* are pivoted at *u*, *t* to levers *p* which are strapped to the arms of the aeronaut. The wings are operated by ropes *e* attached to the feet of the operator and to levers *a* on the crosshead *b* which they cause to slide in the slotted guide *h*. The crosshead moves upwards when the right hand cord, Fig. 2, is pulled, the lever moving about the pin *d* in the upper end of the rod which is pivoted at *z*; at a certain point the pin slips to the other end of the slot *c* in the lever *a* when the crosshead is drawn downwards by the continued movement of the right hand rope, and produces the downward movement of the wings. Their horizontal movement is effected by causing the pin *k*, through which the motion of *b* is transmitted to *s*, to slide in an adjustably inclined link *j*. This link *j* has a slight vertical movement about the fixed ends of the links *l*, *m*, which is limited by the length of the slot in the rod *n*. The length of stroke of the wings is adjusted in length by altering the position of the levers *p*.





Propelling and Steering.—On masts *c* in the car *a* are wings *d*, actuated by fluid pressure in the cylinders *s*, which is supplied through the masts from a pump in the car. The upper wing on one side and the lower one on the other are actuated by the same cylinder, the fluid-pressure acting between the two pistons to force them apart and draw them together. One pair of wings only may be carried on a mast, viz., that pair which is



10,239. May 23, 1895. **Aerial Machine.** MARSHALL, J., 23, Rockingham Terrace, Bi dwell, Barnsley, Yorkshire.

operated by one cylinder. The wings may act alternately on the different masts. Steering is effected by a pivoted vertical plane.

Recent Publications.

"*Parakites*," by G. T. Woglom (G. Putnam's Sons, New York), is a well-got-up, plentifully illustrated book describing the practical construction of a very ordinary form of kite. "Parakite" was the name that Simmons gave to an invention of his some 30 years ago, which was supposed to be a combination of kite and parachute, but Mr. Woglom, ignoring this, explains that he so designates his kites because he considers it something "beyond the kite—an advanced kite." The book commences with an interesting chapter on Oriental kites—Chinese, Japanese, and Javanese—including a graphic description of a kite battle. One might then have expected some description of other forms, European and American, that have been tried, especially considering the number of recent experiments with Hargrave's and other varieties, but the author takes us at once to his own invention, which is of that form usually known as the Malay. He discusses in detail the cover, of paper or silk, the framework, the strings, and methods of knotting. But, though it may seem remarkable that a book can be filled solely with such details, yet it is by no means exhaustive. As an instance, the author discusses under the heading of framework, the relative values of pine and spruce, yet makes no mention of bamboo, a substance much used by most kite constructors. Some large photographs are reproduced, said to be taken from the kites, but these are somewhat disappointing, as they are taken at only a small angle of depression from the horizontal, and present no feature other than would be obtained by a photograph taken from the top of any high building. Frequent reference is made to the great progress which these kites are supposed to have made over previous ones, and the inventor is evidently under the impression that his kites are not only wonderfully constructed, but of enormous size. We gather that his largest kite was 10 ft. high. Members of our Society may remember how Capt. Baden-Powell showed them, a few years ago, a kite 36 ft. high! Beside this Mr. Woglom's biggest is but the merest toy. Still this book, as far as it goes, is a laudable attempt to impart practical information, and not only kite-flyers, but all aërial investigators may find many a useful hint contained within its pages.

Notable Articles in Periodicals during 1896.

Invention, Feb. 15, 22, and 29.—"The Best Shape for an Air Ship." V. E. JOHNSON, M.A.

Scientific American, March 14.—"Recent Experiments in Scientific Kite-Flying." Illustrated. J. B. MILLET and C. H. LAMSON.

Daily Graphic, March 11; *Westminster Gazette*, May 9; *Scientific American*, June 13.—"Accounts of Andrée's Projected Balloon Journey and Method of Balloon Steering."

Nature, May 28.—"Experiments in Mechanical Flight." S. P. LANGLEY.

Sunday Times, June 14.—"Some Facts about Flying Machines." CAPTAIN BADEN-POWELL.

Times, June 16.—"Flying Machines." Letter by H. S. MAXIM.

Invention, June 20.—"Will the Coming Man Fly?"

Scientific American, Aug. 22.—"Artificial Flight."

Glasgow Herald, Aug. 22.—"Flying Men." W. E. GARRETT FISHER.

Saturday Review, Aug. 22.—"Possibility of Human Flight." D. ARCHIBALD.

Saturday Review, Sept. 5.—"Possibility of Human Flight." P. PILCHER.

Saturday Review, Sept. 12.—"Possibility of Human Flight." D. ARCHIBALD.

Daily Chronicle, Sept. 5.—"How to Fly." D. ARCHIBALD.

St. James' Budget, Sept. 11.—"Dr. Wolferts' Steerable Balloon." Illustrated.

Westminster Budget, Sept. 18.—"The Art of Flying."

English Mechanic, Sept. 25.—"Scientific Kite-Flying." A. SHIPPEY.

Pall Mall Gazette, Dec. 14.—"Naval and Military Kites." D. ARCHIBALD.

Digitized by Google

0.5
45

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF MICH
AUG 4 1910

THE AERONAUTICAL JOURNAL



No. 2. APRIL, 1897. VOL. 1.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	1
LANGLEY'S AERODROME	1
"FLYING MACHINES." LECTURE BY P. S. PILCHER.	1
SOARING FLIGHT. E. OAKES	4
COMPRESSED AIR MOTORS	5
MAN-LIFTING WAR KITES. *Illustrated*	5
THE FRENCH POLAR BALLOON EXPEDITION	8
THE CELLULAR KITE. L. HARGRAVE. *Illustrated*	9
EXPLORATION OF THE ATMOSPHERE BY BALLOONS	11
ASCENT OF A SQUADRON OF WAR BALLOONS IN RUSSIA	11
NOTES: THE UPPER RHINE AERONAUTICAL SOCIETY—THE COST OF WAR BALLOONING—KITES FOR METEOROLOGICAL INVESTIGATIONS—GORDON'S SOARING MACHINE—A GUNPOWDER MOTOR—METEOROLOGICAL FORECASTS—NEW PROJECTS FOR AERIAL NAVIGATION—SOME NOVEL IDEAS ABOUT ARTIFICIAL FLIGHT	12
RECENT PUBLICATIONS	14
FOREIGN PERIODICALS	16
NOTABLE ARTICLES	16
APPLICATIONS FOR PATENTS	16
PATENTS PUBLISHED	17

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

THE AERONAUTICAL JOURNAL

APRIL, 1897.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 8s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd.,
4, Bolt Court, 12, Gough Square,
and 4, Birchin Lane, E.C.

ADVERTISING TERMS:—10/- Per Inch, Single Column.

NOTICES
OF
The Aeronautical Society.

A Meeting of the Council was held on March 26th.

The following gentlemen were elected Members of the Society—

MAJOR-GENERAL SIR CHARLES WARREN, G.C.M.G., K.C.B., R.E.

MR. PERCY S. PILCHER.

PROF. G. F. FITZGERALD, F.R.S.

CAPT. G. PHILLIPS, R.E.

MR. P. SPENCER.

MR. T. J. BENNETT.

MR. A. PEARSE.

MR. S. CATTLE.

The following Members were elected to the Council, viz. :—

MAJOR-GENERAL SIR C. WARREN.

PROF. G. F. FITZGERALD.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Langley's Aerodrome.

Even after making due allowance for the fervid utterances of an inventor flushed with success, the statement made in his annual report to the Smithsonian Institute at Washington, by such a scientist as Professor Langley is somewhat startling. He announces that he has reached a measure of success with his experiments which seems to justify him in making the statement "that mechanical flight has now been attained." There will, of course, be many who will make light of such an announcement, and look upon it as being, to say the least, premature. But, on the other hand, supposing the accounts we have received of the experiments, such as we published in our last number, to be correct, there can be little room for doubt but that a very successful *model* has been made. A horizontal flight of 1500 yards by a machine carrying its own motor is indeed a big step. It is true that that which may succeed as a model will not necessarily succeed when constructed of a larger size, but it must be remembered that this particular model is not like the flimsy little toys we have so often seen. A spread of wing of 14 ft., a steam engine capable of exerting more than one-horse power, a total weight of some 30 lbs., tells of something more than the model as hitherto understood by aviators. Then again, in considering the practicability of constructing a large apparatus, we have the recent experiments of Mr. Maxim, which go to show that the building of a huge machine with very powerful engines presents no insurmountable difficulty. However, most of us have already become convinced that a flying machine has theoretically and scientifically been proved a possibility. It is the practical details of construction and the efficient management that we have yet to learn. If Professor Langley now starts to put together a larger machine, there is every probability that within a year or two we shall be very near our desired goal.

Mr. Pilcher on Flying Machines.

On January 21st a lecture was delivered in Dublin, before the Military Society of Ireland, by Mr. P. S. Pilcher, on "Experiments in Flying Machines." General Viscount Frankfort de Montmorency, commanding the troops in Dublin, presided. The lecture was illustrated by numerous limelight views.

Mr. Pilcher began by pointing out that the history of experiments with flying machines has been up to the present more or less a history of disasters. After referring to the abortive attempts of Roger Bacon, of J. B. Dante, and of Le Bris, who, it may be remembered, was one of the first to use a simple soaring machine, the lecturer described in detail the experiments of Lilienthal. This experimenter

Digitized by Google

tried his first machine in 1891. It had about 100 sq. ft. of surface. In 1895 Mr. Pilcher saw him experiment with a machine of 150 sq. ft., which was roughly made almost entirely of peeled willow sticks, covered with cotton shirting. In the illustration shown, the man is holding the machine in the position it would be when flying, with his forearms passed through padded tubes, and his hands holding a cross-bar. This is the only way in which he is attached to the machine, so that he can, when standing on the ground, place the machine at any angle to the wind, and when supported by the air he can move his body a considerable distance forwards or backwards or sideways so as to preserve his balance and guide the machine. Professor Fitzgerald has one of these machines in Dublin.

To fold up, the front of the sail is unhooked from the front of the machine; all the spokes in the sail revolve round, and thus the machine shuts up quite small.

At first Lilienthal used to experiment by jumping off a spring board, with a good run. Then he took to practising on some hills close to Berlin. In the summer of 1892 he built a flat-roofed hut on the summit of a hill, from the top of which he used to jump, trying, of course, to soar as far as possible before landing.

One of the great dangers with a soaring machine is losing forward speed, and slipping backwards; or, having lost forward speed, inclining the machine too much down in front, and coming down head first. Lilienthal was the first to introduce the system of handling a machine in the air merely by moving his weight about in the machine; he always rested only on his elbows or on his elbows and shoulders.

This method of support, although it appears uncomfortable, is not really so bad as it seems, and one can soon get accustomed to it. It allows great freedom in moving one's weight about, and gives one an excellent command of the machine when standing on the ground. It has often been suggested that it would be a good plan to have a pair of stirrups to fit one's feet into while in flight, to have a net to sit in, or some such device to relieve the weight on the arms; but so far the length of flight has never been so long as to make such a thing necessary, and anything of this kind would be an encumbrance, and would hinder free movement, fidget one, and keep one from slipping out of the machine quickly in case of accident.

When Lilienthal made a good flight he used to land 300 ft. from the centre of the artificial hill, 50 ft. high (which he had had made in 1892), having come down at an angle of 1 in 6; but his best flights have been at an angle of about 1 in 10.

If it is calm, one must run a few steps down the hill, holding the machine as far back on oneself as possible, when the air will gradually support one, and one slides off the hill into the air. If there is any wind one should face it at starting; to try and start with a side wind is most unpleasant. It is possible after a great deal of practice to turn in the air, and fairly quickly. This is accomplished by throwing one's weight to one side, and thus lowering the machine on that side towards which one wants to turn. Birds do this same thing—crows and gulls show it very clearly. Last year Lilienthal chiefly experimented with double surface machines. These were very much like the old machines with awnings spread above them.

The object of making these double surface machines was to get more surface without increasing the length and width of the machine. This, of course, it does; but I personally strongly object to any machine in which the wing surface is high above the weight. I consider that it makes the machine very difficult to handle in bad weather, as a puff of wind striking the surface, high above one, has a great tendency to heel the machine over. The machine shown in this slide had about 250 square feet of surface.

Herr Lilienthal kindly allowed me to sail down his hill in one of these double surface machines last June. With the great facility afforded by his conical hill the machine was handy enough; but I am afraid I should not be able to manage one at all in the squally districts I have had to practise in over here.

Herr Lilienthal came to grief through deserting his old method of balancing. In order to control his tipping movements more rapidly he attached a line from his horizontal rudder to his head, so that when he moved his head forward it would lift the rudder and tip the machine up in front, and vice versa. He was practising this on some natural hills outside Berlin, and he apparently got muddled with the two motions, and in trying to regain forward speed after he had, through a lull in the wind, come to rest in the air, let the machine get too far down in front, and came down head first, and was killed.

The object of experimenting with soaring machines is to enable one to have practice in starting and alighting and controlling a machine in the air. They cannot possibly float horizontally in the air for any length of time, but to keep going must necessarily lose in elevation. They are excellent schooling machines, and that is all they are meant to be. When power, in the shape of an engine working a screw propeller, or an engine working wings to drive the machine forward, is added, then a person who is used to sailing down a hill with a simple soaring machine will be able to fly with comparative safety. One can best compare them to bicycles having no cranks, but on which one could learn to balance by coming down an incline. It should be much easier to keep a true balance in the air, when a motive power has been added, for in soaring it is less difficult to balance with a wind than without one, and in watching birds one can see how much less they have to balance themselves when they are flapping their wings than when they are soaring with their wings outspread and still.

Digitized by Google

Illustration 5 shows a machine which Lilienthal made in the summer of 1895, in which more than simple soaring is attempted. The extremities of the wings are made to flap, and constructed so that flapping would drive the machine ahead. The power was derived from a cylinder of compressed carbonic acid gas, and when Lilienthal pressed a valve with the thumb of his right hand, a piston in a working cylinder made a stroke, and caused the wings to give one flap. With this type of engine he was only able to carry enough power to last for about half a minute. He had several minor accidents with the mechanism of the machine, which delayed him, so that he made no real horizontal flights with it.

Mr. Pilcher then referred to his own experiments, of which he said: "I began to make my first soaring machine at the beginning of 1895. I had seen photographs of Lilienthal's apparatus, but I purposely made mine before going over to Berlin to see his, so as to get the greatest advantage from any original ideas I might have out. I was not able to make my first trials with this machine till June, 1895, after I had seen Lilienthal fly."

After describing his first machine, which had only a vertical rudder, he spoke of his next development. In this "there is a horizontal rudder as well as a large vertical rudder. Without the horizontal rudder I was able to do nothing—it was not until I had put on the horizontal rudder that I was able to leave the ground at all. Lilienthal told me that a horizontal rudder was absolutely necessary. I would not believe him, but found out that he was quite correct." In this machine the wings were very much turned up at the points, with the idea of facilitating the transverse balance.

"The upturned wings were all very well if there was no wind, or if the wind was steady; but if the wind shifted slightly sideways, and came on to one side of the machine, it would tend to raise the windward wing and depress the lee one, and capsize me sideways, which always meant a break. To obviate this, I built a second machine quite flat transversely, with the whole surface considerably raised so as to keep the wing tips a good distance off the ground."

Mr. Pilcher's machines vary from 150 to 300 sq. ft. surface, and weigh 50 to 80 lbs. The greatest distance he has covered is 100 yards.

"The great thing to be learnt with these machines is to land properly. One must before landing get right back in the machine, so as to tip it right up in front, and so bring the machine to rest in the air instead of on the ground.

"You will note that the horizontal rudder is made so that it can be lifted, but cannot be depressed. This seems to allow it to answer the purpose which is required of it, and saves it from getting broken if one tips the machine up a great deal, as is frequently necessary when coming to the ground.

"It is my intention this winter to make another machine very similar to this, but having a small oil engine situated just in front of me on the machine, with a shaft passing over my head, working a screw propeller of about four feet diameter, situated behind me. The machine will be started in exactly the same way as the soaring machines, by running down an incline, and when in the air the screw will be started to revolve, and in this way I hope to be able to maintain horizontal flight. From soaring machine experiments, it appears that an expenditure of energy of about two H.P. per minute is necessary. I shall therefore use an engine of about four H.P., because of the inefficiency of the screw and other losses. The flying speed would be about 30 miles per hour."

The third portion of the lecture dealt with Mr. Maxim's experiments. It was said that this great engineer happened to see some very thin and extremely strong steel tubing in France. Considering over the purposes to which such would be specially applicable, he thought of a flying machine, and thereupon started to construct one. The whirling table and other experimental apparatus having been described, the lecturer showed pictures of Maxim's great machine, and of details of the engines, boiler, and other parts. The aeroplane, it may be remembered, with a length of 104 ft. and a width of 125, presented an area of about 6,000 sq. ft., and the two engines were capable of exerting 360 horse power. Mr. Pilcher, after having described Mr. Maxim's last experiments, ended the lecture by saying: "Since this Mr. Maxim has done very little. I am now working with him, and I believe that we are shortly going to begin a new machine of quite a new type, about which I am not at liberty to speak."

The Chairman then invited discussion.

Capt. Baden-Powell, Scots Guards, said that among the audience there might be many who were not well versed in the subject, and who might not be able to comprehend exactly the object to be gained by these experiments with soaring machines. He might explain, for their benefit, that it was of the greatest value to those who intended ultimately to navigate the air to gain some acquaintance with the practical management of a flying machine in mid-air, to understand the effect of balance, and the results of the varying gusts of wind which an aerial navigator was likely to encounter. Much could be learnt in this way even while soaring down a hill-side. He had hoped to have heard something more from the lecturer with regard to Mr. Maxim's future intentions, but he had kept that very dark. There was no doubt we were getting nearer and nearer to the solution of the problem of flight, and when it did come it would be of the greatest importance from a military point of view, as it would then be possible not only to observe the enemy, but also to attack fortifications from above.

The Chairman said that, while he had not studied the subject very much, he was rather surprised to hear that flying machines had claimed so much attention so many centuries

Digitized by Google

ago. No doubt within the last ten years considerable progress had been made. But a few years ago to take such a problem in hand would have been considered the folly of a "crank" or person hardly sound. However, scientific men are now taking up the problem, and, so far as he could understand it, it seemed to be demonstrated that not only would we be able to fly, or rather that some machine would be invented to enable us to fly in the air, but that from a military point of view, the invention would be useful. For instance, a town might be bombarded from such machines, and it was possible that if the enemy had such machines they would try to get at the occupants of the others also. A few years ago, when cycles were proposed for use in the Army, the idea was rather scoffed at, but every army now used cycles, and probably before many years we would find flying machines coming into use in the same way.

Mr. Pilcher, having been voted the thanks of the meeting, suitably replied.

Soaring Flight.

The failure of the Henson machine (London, 1843) has been so repeatedly attributed to lack of power that it has become a commonly accepted idea that if this want be supplied, the thing is virtually accomplished and flight assured. In consequence of this belief, we see a number of machines posing as solutions of the problem of aerial navigation, all built on substantially the same plan, and being merely modifications of the Henson machine, including and retaining its defects and faults in construction. Horizontal and perpendicular rudders incapable of controlling the craft and propelling wheels so located as to continually disturb or destroy longitudinal equilibrium, may be relied upon to produce like results, however efficient the engine may be.

The Henson scheme is "to propel the aeroplane at a sustaining speed by the continuous thrust of screws." It is totally lacking in the essential element which characterises soaring flight as accomplished by birds.

The kind of flight attempted by these machines really bears more resemblance to flapping than to soaring flight.

In flapping flight birds are propelled by continuous thrust. The inclined position of the flapping wing in both ascending and descending movement furnishes a horizontal component of backward thrust, which is the equivalent of and mechanically the same as the action of a one-bladed screw (propeller) having similar pitch.

In true soaring flight birds are propelled by utilizing the motor powers of the aeroplane, and by virtue of the same construction and manoeuvres they may avail themselves of the extraneous aid of favouring winds.

The scheme for which I contend is, to so construct the machine as to enable it to fly in the same manner and be sustained and propelled by the same natural forces employed and utilized by soaring birds. Soaring flight is accomplished by birds with only a small portion of the power required to maintain flapping flight, and there is the same difference between my scheme and the Henson scheme in economy of power.

All soaring birds possess the ability to fly by flapping; they also know an easier way. Their ability to soar comes largely from size and weight. These are attributes which the flying machine will possess in greater degree, apparently giving it an advantage over the birds, and the same construction which serves to endow the machine with these powers also assists it to rise from the level ground, and enables it to alight without shock or jar.

The California machine recently advertised is said to be under perfect control: "it has a tail like a bird."

All of the machines recently exploited have similar appendages, but they are lacking in one attribute which a bird's tail possesses in an eminent degree.

A bird's tail is capable of striking vigorous blows upon the air. Birds do not make a succession of strokes with the tail, for the reason that one stroke is usually sufficient to correct their poise.

When a bird is moving forward the extended tail has the function of a horizontal rudder, with efficiency in proportion to speed of flight, and in case of soaring birds when under way this may greatly assist to control their position. But when rising from the ground or lighting, the rudder function is inoperative, and they make strokes with the tail just as smaller flapping birds may be observed to do.

There is another point which may be considered in this connection, wherein birds differ from the regulation flying machine.

The wings of birds have considerable latitude of motion fore and aft, and by simply moving them forward or backward a change in the longitudinal centre of gravity is made, and this is the way that birds in the act of soaring or sailing guide themselves on ascending or descending planes, and with all the grades at their command travel up hill or down as suits their whim.

The flying machine that has no equivalent devices must depend solely upon the horizontal rudder function of the tail, which is a lame dependence, and not so much like a bird as is supposed.

The regulation flying machine is also usually provided with a perpendicular rudder or tail, which is expected to control the direction of flight laterally or turn the craft right or left. This is not like anything found in nature among aerial creatures, and, being thoroughly inefficient, no argument is needed to condemn it. The swinging from side to side of a perpendicular rudder large enough to be effective changes the transverse centre of gravity of the craft, and tilts the machine sidewise.

Herr Lilienthal advocated and adopted curved surfaces because they give more lift

from a given area. This construction belongs to flapping wings, and may be serviceable in kites, but is of doubtful utility in soaring machines. Whenever a machine supported by one set of aerocurves or curved wings moves at a supporting speed, the tendency of the craft to follow the line of curvature of the supporting surface asserts itself noticeably, and with a moderate increase of speed the tendency becomes practically uncontrollable, and a wreck is imminent.

If curved wings are used there should be two sets of them, placed some distance apart, as shown in my machine. Then the path of the craft being the resultant of two sets of curves is approximately straight.

Curves, whether intentional or accidental, are a disturbing element in the soaring machine. It is true that the wings of birds are curved, but the birds are also provided with skill, strength, and appliances to manage them.

It may not be amiss to remember that the curvature of the wings of birds serves other purposes beside the requirements of flight. Birds are not always on the wing, and when walking or roosting the curvature serves an obvious purpose to enable the folded wing to fit the body and protect it from cold and wet. It also helps to give that comeliness of figure which nature chooses to bestow.

EDWARD OAKES.

Compressed Air Motors.

In a paper* read before the Liverpool Branch of the Horseless Traffic Association, Mr. Rhys Jenkins, M.I.Mech.E., discusses the application of "Compressed Air as a Motive Power for Road Vehicles." He bases his conclusions as to the production and expenditure of compressed air to a large extent upon the results actually obtained in practice in reference to tramway work, and upon the work done by the large air compressing plant designed by Professor Riedler for the Paris Compressed Air Supply.

While the pressures used in ordinary steam practice are also those best suited for compressed air motors, the necessity of storing an adequate supply of air within a reasonable space compels the adoption of very much higher pressures in the reservoirs. Pressures as high as 2,000 pounds per square inch are now in use for tramway work, but in the paper 1,000 pounds is taken as the standard pressure.

With a coal consumption of 2 pounds per indicated horse power per hour, it is estimated that air at this pressure may be produced at the rate of 5 pounds per pound of coal.

Great stress is laid upon the advantage of dividing the compressing process into two or more stages, with intermediate cooling.

The weight of the reservoirs for a given weight of air stored or for a given volume of free air is a very important consideration, but it is practically independent of the pressure. With a working stress of 10 tons per square inch, it amounts, including connections, to 10 pounds per pound of air. In the case of a vehicle, it is stated that the weight of the reservoirs, engine, gearing, &c., for a run of 10 miles would amount to one-third of the gross weight.

As the store of air is used up the pressure in the reservoirs falls, until it reaches a limit below which it cannot be usefully employed. The air then remaining is dead, and having regard to the fact that the vehicle has to carry not merely the air itself, but the reservoirs as well, the weight of which is far more serious, it is desirable that the motor should be arranged to work at as low a pressure as possible, so as to reduce the amount of the dead air.

The most economical way of working would be to admit the air directly from the reservoirs to the motor cylinders, but this means a very great range in the initial working pressure, which entails undesirable complications, such as multi-cylinder compound engines, variable expansion gear, &c., so that it was best to relinquish the advantages of high initial pressures, and to pass the air through a reducing valve, whereby a constant working pressure of, say, 180 pounds is maintained. The air may, however, be worked below this pressure by a variation in the ratio of expansion, down to, say, 90 pounds.

The importance of heating the air before using it in the motor cylinders is pointed out. By heating to a temperature of 320 deg. Fah., which may be effected at a trifling cost in a small coke stove, or by a petroleum burner, the volume of the air is increased by one half, and the consumption reduced in the same proportion; while by making use of a compound engine and reheating the air between the cylinders, the consumption is reduced by one-half. The consumption of air used in this way is 24 pounds per indicated horse power per hour. By saturating the air with steam, as in the Mekarski system, even better results would be obtained.

Man-Lifting War Kites.

Recent experiments in America are attracting attention again to the subject of man-lifting kites, and it may be of interest to briefly recapitulate what has so far been accomplished in this line.

Passing by the achievements of Pocock, early in the century, of which no details are procurable, and the futile attempts of Mr. Simmons in England and M. Maillot in France, the first well-authenticated occasion on which a man was raised by a kite was on June 27th, 1894, when Capt. Baden-Powell, Scots Guards, conducted some experiments at Pirbright Camp

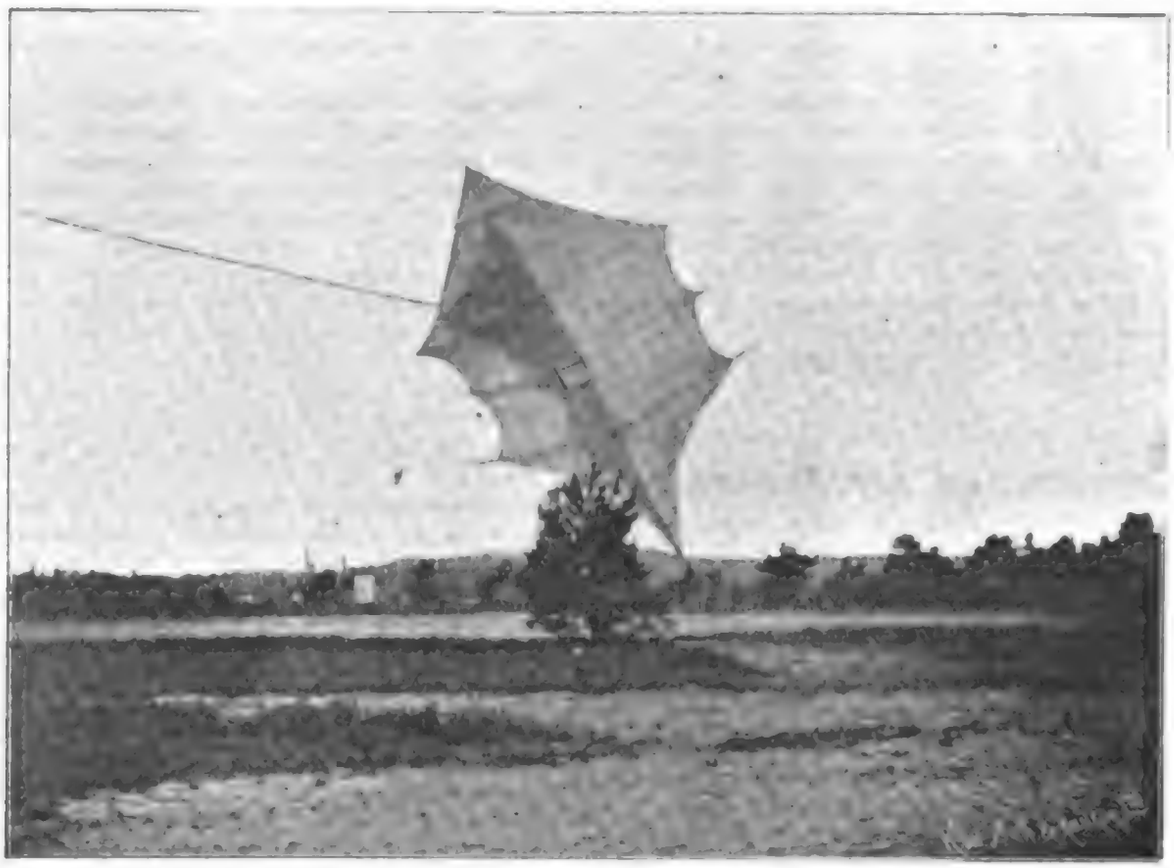
*Reported in full in *The Automotor*, 17th March, 1897.

with a huge kite 36 ft. high. This consisted of a large hexagonal sheet of cambric, stretched on a framework of bamboo, presenting an area of about 500 sq. ft., and was flown on two lines, from which a basket was suspended. By this means men were repeatedly carried up to a height of about 10 ft. or so, the apparatus not being considered sufficiently reliable to risk attempting a higher ascent. Indeed, in the second photograph which we reproduce, and which gives a good idea of the size of the kite, it may be seen that an accident has happened, one corner of the kite having broken away from the framework. It is, of course, an extremely difficult matter to build such an apparatus without any sort of previous experience as to the strength required for the various parts. These experiments were continued almost daily for some weeks, men being successfully lifted on many occasions.

Capt. Pilcher about this time made some trials with a number of canvas discs attached to the string of a small kite, and by this means was more than once lifted off his legs.

On November 12th, 1894, Mr. L. Hargrave, in Australia, sent up four of his large "cellular" kites, with a result he thus describes:—"In about a quarter of an hour the wind freshened and raised me, when I found the velocity of the wind to be 18.6 miles per hour. The wind fell lighter, and I came down. Several more ascents were made, but not of sufficient duration to read the anemometer. However, a long and strong puff eventually came, and sent me up like a shot. A careful reading showed the wind velocity to be 21 miles per hour, with 240 lbs. pull on the spring balance. The weight aloft was:—The four kites, 30 lbs.; line, toggles, etc., 7 lbs.; man, 168 lbs.; total 208 lbs., raised by the 232 sq. ft. of lifting surface. . . Although the altitude was nothing to speak of, the conditions would be identical if the kites had been held by a mile of piano wire instead of the clothes line."

In April and May, 1895, Capt. Baden-Powell again tried experiments with some big kites at Pirbright, and on several occasions a man was lifted, and sandbags amounting to 6 stone weight carried to a height of about 200 ft. On one occasion, when there was practically no wind, 12 men ran along towing the kite, which was thus made to lift a man, and a few days afterwards the line was made fast to a cart and horse.



Finding many difficulties in the practical working of these big kites, Capt. Baden-Powell took to an arrangement consisting of a varying number of smaller kites, of about 110 sq. ft. area, and with them quite a series of experiments were made in the autumn of 1895. On eleven different days a man was lifted, four to seven kites being used according to the strength of the wind. On one occasion a weight of 9 stone was kept floating at a height of 300 ft. for the greater part of the day.

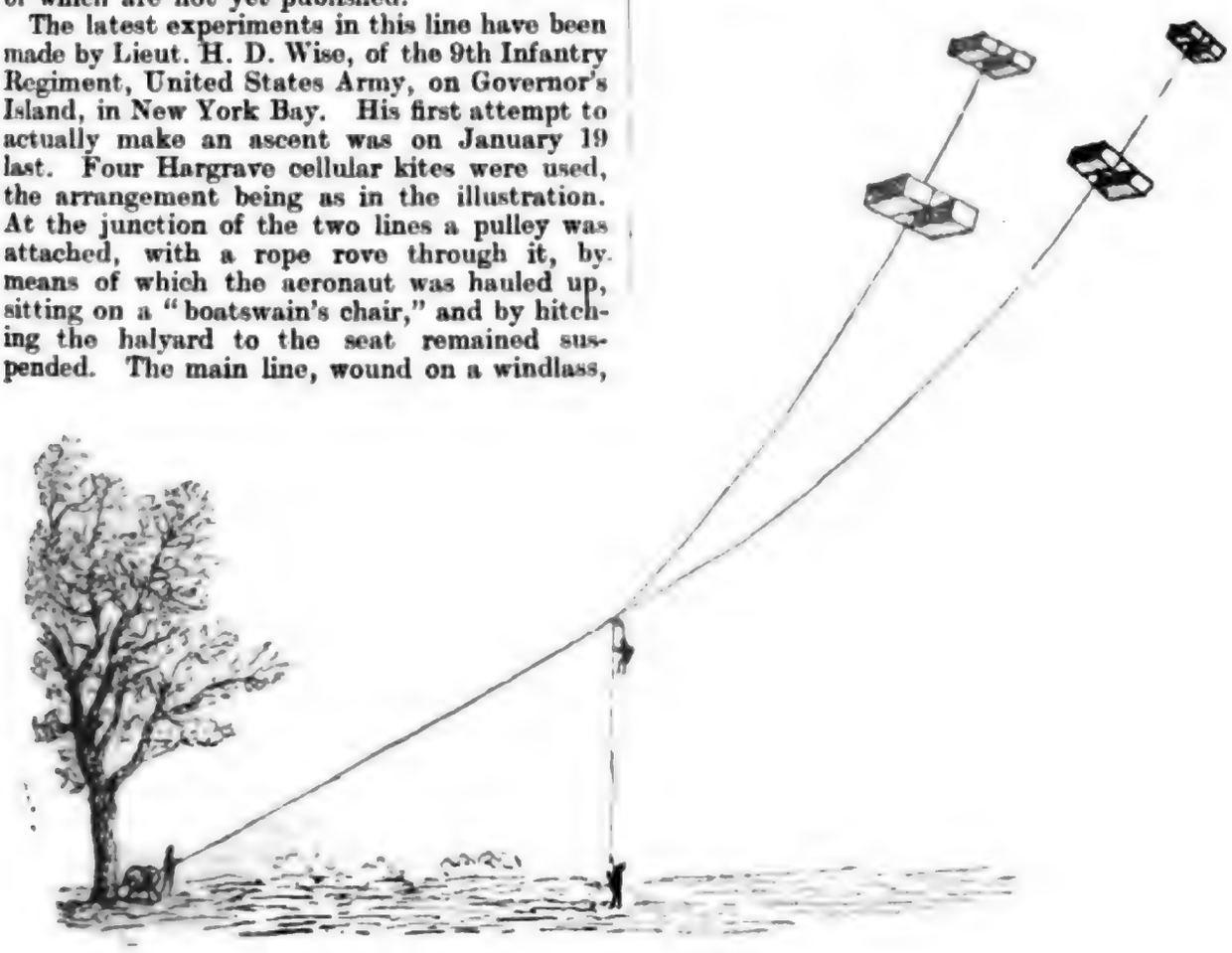
In September Capt. Baden-Powell exhibited his apparatus before the British Association at Ipswich, on which occasion, he, and others in turn, were lifted to a height of 100 ft., this being the length of the perpendicular rope by which the car was hauled down. A parachute

Digitized by Google



extended on a framework of bamboo was suspended above the car as a precaution against accident. The apparatus was then taken to Aldershot to undergo official trials, the results of which are not yet published.

The latest experiments in this line have been made by Lieut. H. D. Wise, of the 9th Infantry Regiment, United States Army, on Governor's Island, in New York Bay. His first attempt to actually make an ascent was on January 19 last. Four Hargrave cellular kites were used, the arrangement being as in the illustration. At the junction of the two lines a pulley was attached, with a rope rove through it, by means of which the aeronaut was hauled up, sitting on a "boatswain's chair," and by hitching the halyard to the seat remained suspended. The main line, wound on a windlass, was then run out, until Lieut. Wise had attained a height of 42 ft., where he remained for some five minutes. He says, "I was



amazed to see how little effect the weight had upon the main line. There was very little sag. Had I so desired I could have gone up much higher. I had no parachute, however, and having accomplished my purpose, I did not care to run any unnecessary risks." The kites are made of a framework of spruce, covered with cotton cloth, the areas being 22½, 40, 90, and 160 sq. ft. respectively, so that the total area supporting the weight was 312½ ft. The main line consisted of a half-inch manilla rope.

Mr. Lamson and others have also been experimenting, but so far have not, we believe, succeeded in raising a human being.

The principal use of these kites, from a military point of view, would be for observation purposes, instead of a captive balloon, than which they are cheaper, more portable, less vulnerable, and able to ascend in strong winds.

But there are also many purposes to which such an apparatus could be applied. To explorers, as in Arctic regions, they would afford a means of surveying the neighbourhood and obtaining a distant view. Steeplejacks and mountaineers would find them useful for attaining otherwise inaccessible places. The showman might find them an attractive amusement to those who would venture on the trip aloft, especially during race meetings and such-like assemblages. As a means of rescue from wrecks, or for getting to or from lighthouses or ships, for crossing rivers, and for very many more purposes they might prove of the greatest use. But such apparatus is also most interesting as a stepping-stone in aerial navigation. A kite which, during a calm, will lift a man while being towed along, is not far removed from the propelled aeroplane.

The French Polar Balloon Expedition.

From the *Pall Mall Gazette*.

To ascertain what is exact in the rumour of a French expedition to the North Pole, having for chief pilot M. Louis Godard, I called on that gentleman, who at once supplied me with all particulars. M. Godard is a distinguished aerostatic engineer, who builds, as well as commands, aerial ships. For the last twenty years he has been practically connected with aerial navigation. He is on the shady side of thirty years of age; is about 5 ft. 8 in. in stature, and weighs some eleven stone. He is of quiet, unassuming manners, but the possessor of an iron will and nerves of steel. In a word, a "daring pilot in extremity."

"And what, Monsieur le Chef, is the situation of your project?"—"It is supported by four Parisian journals, namely:—"Le Figaro," "Le Petit Journal," "Le Matin," and "Le Petit Parisien." The Committee has for president M. Rambaud, Minister of Public Instruction, and five members of the Académie des Sciences, including Mr. Faye, whose name alone is a guarantee for the feasibility of the project and a stimulus for its success."

"Do you anticipate serious difficulties in the execution of your plans?" — "No; there is nothing new in the idea of crossing the 'banquise boréale' by means of a balloon, whose course nothing can arrest, if well managed, and a favourable current exists. Since 1893 my associates and myself have studied the present plan, and conclude that, with a balloon suitably constructed and a well-chosen crew, the enterprise may be said to present no risks. Further, our balloon will not follow any marked-out route."

"Will your balloon be large?"—"It will *per se* cube in round numbers 11,000 metres; will have a circumference of 86 and a diameter of 27 metres. It will be built with silk, consist of two independent envelopes, one sheathing inside the other, but both uniting at base and summit by valves, furnished with similar valves at the circumference, and arranged according to a special system. It will also have an air balloon of a small but determined capacity, attached, to aid in maintaining the geometric form of the balloon, to assist in working any scheme of deviation, and in contributing to the floating in cold regions. The netting, its hooping, and peculiar cordages, will weigh 1,525 kilos; the steadying guide-rope, cable, anchor, &c., 520 kilos. The car will weigh 625 kilos, and be rectangular in shape, of a capacity of 2 by 2½ by 2 metres, and covered overhead; on its roof, or deck, the working operations will take place. The interior of the car will consist of cabins in which to repose, eat, record observations, one being reserved for a laboratory. The weight of the balloon proper with these fittings will be 4,550 kilos."

"And your crew?"—"It will comprise seven persons, representing a total weight of 560 kilos, or an average of 12½ stone per individual. The provisions are calculated for 120 days, at the rate of 3¼ lb. daily per person, and will represent a total weight of 1,200 kilos. Photographic apparatus, scientific instruments, folding boats, sledges, arms, duplicate ropes, anchor, ballast, &c., will make a total weight of 7,450 kilos, which, added to the 4,550 kilos already mentioned, will represent a grand total of 12,000 kilos. The ballast alone will weigh 3 tons 12 cwt., and will consist of small shot and water."

"What about the inflation?"—"That will be effected with pure hydrogen gas, sufficient to tide over a voyage of forty days; but with the twelve gasometer balloons, suspended between the car and the equatorial section of the balloon, each cubing 250 metres additional hydrogen, the journey can be extended to sixty days. One cubic metre of pure hydrogen is estimated to raise a weight of 2 lb. 6 oz. The leakage of gas, based on the working of captive and military balloons during several years, is calculated at 1½ per cent. per twenty-four hours. Even allowing the loss to be 2 per cent. sufficient hydrogen would remain for a

voyage, that is to say, to float in the air, during fifty days."

"How long do you expect your exploration journey to last?"—"With a favourable wind, moving at the rate of four metres per second—the mean velocity of the wind at Spitzbergen, based on 1,000 observations taken during fine weather, and when there is no night—or fifteen kilometres per hour, the balloon would travel daily 360 kilometres, or 225 miles—that is to say, 13,500 miles, during sixty days. But the contemplated voyage of exploration is not expected to exceed twelve or fifteen days, equivalent to a total journey of 3,375 miles. Now, the distance of unexplored territory between Spitzbergen and Behring's Straits is about 2,000 miles, so that a liberal margin has been allowed for the run."

"How do you propose to prepare the hydrogen gas?"—"The Minister of Marine will be asked to place a steamer, with a crew of 30 hands, at the disposal of the Committee, to transport the cargo, some 300 tons, to Spitzbergen. To produce the requisite amount of gas—18,000 cubic metres—including accessories, &c., 179 tons of sulphuric acid, and 72 of iron, will be needed. Pending the inflation no shelter will be required for the balloon; it can be safely anchored to the ground, a 'captif,' and fully able to resist a gale blowing at the rate of seventy-eight miles an hour."

"What about your crew of seven brave men, commencing by your worthy self?"—"My first assistant, who is my colleague and associate engineer, will be M. Surcouf, who is well known as an experienced aeronaut; there will be two sub-assistants, one meteorological chemist, one Arctic navigator, to be nominated by the Geographical Society, and a navy surgeon to be selected by the Admiralty."

"What will be the cost of the expedition in question?"—"Ten thousand pounds sterling, to be obtained from promised donations, public grants, and a national subscription. Conferences are on the eve of being organized all over the country, to enable France to have the honour of solving the mystery or the enigma of the North Pole."

"But, Monsieur le Chef, what respecting the peril, the unknown?"—"No danger daunts us, nor do we value or estimate the difficulties as excessive, secured as we will be by every scientific and mechanical appliance." M. Godard is of the same mind as the Knight of Snowdon:

"If the path be dangerous known,
The danger's self is lure alone."

The balloon duly inflated at Spitzbergen, the "let go" will be pronounced on the first favouring breeze. If the expedition cannot attain the Behring's Straits, but be blown back, the travellers will bow to the inevitable; but they are resolved to remain "up" fifty to sixty days, so as to realize that fact alone, which will be no insignificant "lever de rideau" for the grand piece certain to succeed later.

Before leaving my learned friend I asked him his opinion about the Andrée Polar Expedition. M. Godard merely observed he did not approve of the principle of the construction of its balloon, though made, all the same, in M. Godard's own factory.

*On the Cellular Kite.**

By Lawrence Hargrave.

As there is little doubt that the cellular is a permanent type of kite, a few remarks will be of interest, especially as its action and construction as hitherto explained are somewhat obscure. The first question that suggests itself is, why should the cellular lift more per square foot than the ordinary single surfaced kite? In a kite or flying machine the distribution of the lifting surface is most important. The value of the lifting surface depends within certain limits on the linear dimension that first meets the wind. Thus, a common kite of 25 square feet area cannot show more than about 7 ft. of edge to the wind, whereas a cellular one of 25 square feet area can easily show 20 ft. of edge to the wind.

The great stability of the cellular kite is due to the vertical surfaces. To understand this, it is necessary to grasp the truth, that a perfectly flat kite has no stability; and even with tail and side ropes is an inferior flyer. The more the kite bends back from the longitudinal centre line or backbone, the more stable it becomes. The angle between the two sides is called by flying-machine men the diedral angle, and without this or its equivalent, no flying apparatus will balance with any degree of certainty.

Let A B C be the diedral angle of a kite, B being the end view of the backbone. Resolve A B and B C into their components, and D B E



is the breadth of surface that tends to life the kite, and A D and C E are the heights of the surfaces that tend to steady it. Bisect D B and B E, and erect perpendiculars F H and G K equal to A D or C E, join H K, and F H K G is the breadth and height of a cell having the same lifting power as A B C and (apparently) greater stability.

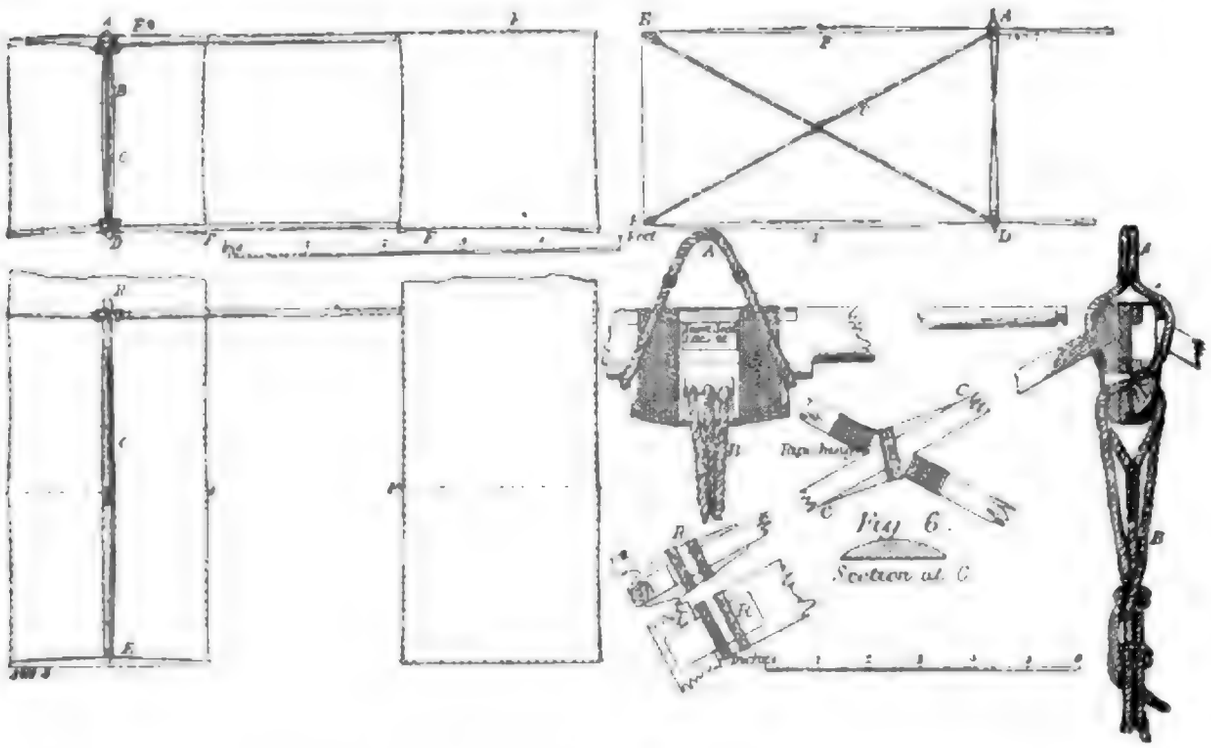
The width of the kite D E is halved, and therefore much less timbering spreads an equal area of lifting surface, to say nothing of the rigidity of the lattice girder construction.

To realise this question of stability from another point of view, let us imagine a flying machine with its lifting surfaces in the diedral fashion A B C, and one with two cells like F H K G, to be on their respective stages, rails, carriages or floats, ready to fly; suppose them to have equal areas, weights and wheel or other bases and to be heading directly to the wind; a momentary change of wind would promptly overturn A B C, but F H K G would only be pushed sideways. Suppose both

* Paper read before the Royal Society of N.S. Wales, Aug. 5, 1896.

machines to be flying at the same speed and to require to turn to the right suddenly. They each port their helm, with the result that the diedral one turns on its beam ends to starboard, and the cellular one loses way, due to the amount of vertical surface, and develops a slight listing to starboard.

A comparison of the scale drawing of a 90 square ft. kite, with Plate 8 of the paper on "Aeronautical Work" read here on June 5th, 1895, will show detail improvements that have lately been made. The 1895 drawing shows the main frame to have had three king-posts and four diagonal wire ties; these are now abolished and the cells brought closer together longitudinally. The frame now consists of two pieces of wood, each three times the length of the cell, united by the ties (B) at the centres of each cell. The effect of this alteration is that the crossings by tape or string hinges to the continuous booms; this brings all compressions of the truss work of each cell into one plane. The outer ends of all the booms have wooden cleats (R) lashed on top and bottom, so that the jackyards (E) fitting exactly between them receive the thrust truly square. The inner ends of all the booms are quite square, and rest in beds on the main frame. There are no metal ferrules, joints, nails, or shoes on the kite. The sticks for bending the surfaces (F) have a versed sine of 1.125 in. They are not steamed, or held bent by a cord or wire. They are simply made in two or three layers of wood united with glue. The sticks retain the form given them, and acquire an extra stiffness due to the glue. The total weight of this 90 square feet kite is 12½ lb.; at least a pound of this might be saved by using light muslin instead of calico.



the kite is equally strong with less material, and it will fold to a close bundle 7 ft. 6 in. long, with a maximum circumference of 16 ins. This makes the question of transport a very simple matter.

The strop for the kite line (D) and that for any kites that may be flown above (A), pull on to the tie of the forward cell, so that no special rigging is required for tandem flying. The fabric of the surfaces can be adjusted easily to any degree of tension by the ties (B); previously it required some effort to fleet the boom shoes along the main frame. The booms (C) for pushing out the jackyards (E) are of plano-convex section instead of being round; this adds a little to their weight, but something is gained by the reduced head resistance, and the lift due to the plane underside of the booms. The booms for the lower corners are continuous; those for the upper corners are joined at

The lifting power at the ultimate strength of the structure is not known; it is estimated to be about 3 lb. per square foot, and that a wind of 30 miles per hour would not break it or make it dive. This kite was flown on July 22, at 2 p.m. You will remember the weather as reported in the "Sydney Morning Herald" next day. One of the jackyards broke at a small nail hole, and one pair of booms fell to the ground, but the kite continued to fly steadily. It is this remarkable stability that makes the cellular form of aeroplane so suitable for flying machines, and it is a matter of surprise to the writer that other experimenters do not adopt it, especially as there is no charge for its use.

For man-lifting purposes, small kites are better than large ones. For instance, a 19 square feet kite has been made that weighs 19 ounces, and folds to about the size of an umbrella; ten of these could be tucked under one's arm, and

Digitized by Google

with a coil of line and a decent breeze an ascent could be made from the bridge of a torpedo boat or the top of an omnibus.

Some confusion has arisen through the apparent ambiguity of the definitions of the dimensions of cellular kites. They fly at such a high angle, and present such a small projected area to the wind, that when viewed from below misunderstanding cannot ensue if:

Length equals the dimension in the direction the wind is blowing.

Breadth equals the dimension horizontally at right angles to the length.

Depth equals the dimension vertically at right angles to the length.

Exploration of the Atmosphere by Balloons.

An international committee, under the presidency of Dr. Hergesell, was formed some time ago with the object of conducting experiments in meteorology, with special reference to observations of the state of the atmosphere at a great elevation. With this object it was decided to send simultaneously from different places on the Continent a number of balloons carrying observers or self-registering instruments. The first experiment was made on November 14th last, when balloons were sent up from various towns. The following table and map give the principal particulars:

Balloon Ascents on 14th November, 1896.

	Capacity of Balloon. c. ft.	Start. Local Time a.m.	Greatest Altitude. ft.	Greatest Cold. °C.	Duration of Voyage. hrs.	Distance Travelled. miles.
Paris	13 055	2h. 6m.	49,500	— 60	4h. 23m.	136
Strasburg ..	12,350	2 0	26,400	— 30	1 20	18½
*Berlin	45,500	2 48	18,480	— 24·4	11 37	—
..	8,750	2 51	19,140	—	1 0	*burst.*
*St. Petersburg	35,000	4 45	15,048	— 22·8 (at 10,500 ft.)	6 45	136
..	—	4 0	4,950	— 13	0 15	—
*Warsaw ..	35,000	3 15	10,470	— 20	9 35	—
*Munich	45,000	6 32	11,050	— 6·5	7 10	124

* Carried men, the others instruments only.



(*From Cassell's Magazine.*)

A second series of ascents was made on February 18th, at about 10 a.m. Two balloons with observers and one with instruments only ascended from Berlin (in the presence of the Emperor). A balloon with recording instruments ascended from Paris, and descended after two hours, having run 63 miles in a N.N.E. direction, attaining an altitude of over 33,000 ft. Other balloons ascended from Strasburg and St. Petersburg.

Ascent of a Squadron of War Balloons in Russia.

The *Militär Wochenblatt* (Jan. 6.), quoting from the *Russische Invalide*, reports on the inspection of the officers attached for instruction to the School of Military Ballooning at St. Petersburg, after their school examination, in order to test their ability to direct free balloons. With this object, three balloons, "Nadajaschny," "Kobtschik," and "Ssmalui," ascended simultaneously, on the word of the commander of the school, at 12.30, on Oct. 14. Each contained 22,500 cubic ft., and was filled with coal gas. There were two officers in each car. The weather was favourable, the wind north, and the velocity of the clouds about 20 miles per hour. The carrying power of the balloons was nearly alike; each had four sacks of ballast. Orders were given to ascend to a height of at least 3,000 ft. On rising, one of the balloons fouled another, but got clear, and at a height of 600 ft. one of them passed so close under the car of another that the occupants of the latter had to shove off with their hands and throw out ballast so as to ascend. This critical situation lasted for about five minutes. Two of the squadron had used each three sacks of ballast on reaching a height of 3,000 ft. At a height of 4,500 to 5,000 ft. all took a southerly direction, and

kept so close together that conversation could be carried on from one to another. For forty minutes after reaching the greatest altitude no ballast was thrown out, and on the latter half of the journey they parted company. At 2.11 p.m., the first balloon descended in a wood-clearing 4½ miles east of Gatschina, having covered 30 miles, of which over three miles was "trailing." At 4.3 the next also landed in a wood, after a journey of 45 miles, but was for some time suspended in a tree, and had afterwards to be removed on sledges. The last of the squadron on descending was also caught in a tree, and had to be brought to the ground with the help of some peasants. The landing was effected at 4.8, after covering 39 miles. All three landed in a line at intervals of about 6 to 10 miles.

The School of Ballooning has taken a prominent part in the exhibition at Nijny Novgorod, where, in a separate pavilion, were shown a great variety of apparatus and appliances mostly invented and made in the school; also photographs of incidents in aerial navigation, photographs taken from balloons, maps, plans and reports, as well as the programme of instruction and a quantity of balloon literature in the Russian language. It is impossible to enumerate all the inventions and improvements which have been made in this field by the staff of the Balloon Park for calculating the direction of the wind and the path of balloons at different heights, their construction, filling, and transport, optical apparatus, measures of security, etc. A Russian writer says:—"We must come to the conclusion that aerial navigation in Russia rests, considering present technical conditions, on a very solid and quite independent basis, in no way inferior to that in other armies. During the ten years' existence of the Balloon Detachment it has not had a single accident, and in this it differs from those of other countries. In many respects, particularly in the investigation of the atmosphere and the use of currents, the Russian Ballooning Service can claim the first position."

NOTES.

THE UPPER RHINE AERONAUTICAL SOCIETY.

We are glad to note that, according to the latest account sent us, this Society, which has only recently been started, seems to be progressing in a most satisfactory manner. The number of members is now over 200, a large proportion being military officers. At the last meeting it was unanimously decided to build a balloon for the Society, forty-two £1 shares being subscribed by 27 members. Experiments with kites were to be conducted every Saturday afternoon. The Secretary is Capt. Moedebeck, Kalbgasse 3, Strassburg.

THE COST OF WAR BALLOONING.

In the Army Estimates for 1897-8 a sum of £4,650 is set aside for the purposes of military ballooning, as against £3,150 last year. £600 is also to be spent on buildings for the Balloon Depôt.

In the Italian Army Estimates 600,000 francs (£24,000) is to be devoted to "Increase, Balloon, and Optical Material."

About £2,300 is said to be the German contribution for military ballooning purposes.

KITES FOR METEOROLOGICAL INVESTIGATIONS.

Mr. H. Helm Clayton, of Blue Hill Meteorological Observatory, writing about the use of kites for meteorological observations, says:—"The ease with which a meteorograph can be lifted to the height of a mile is shown by the fact that it was accomplished three times in four days during August in normal weather conditions. The highest point reached by no means represents the highest point attainable with kites, since at the time of the highest ascent the pull of the kites on the line was 100 lb., while the breaking strain of the line is over 300 lb., so that had there been more wire on the reel a much greater altitude might have been reached. Three, or possibly four or five, miles does not seem unattainable. The importance of such observations for the further development of meteorology is shown by the fact that the weather conditions at the height of a mile above any station differ more from the weather at that station than does the weather at any place within 500 or 1,000 miles at the level of the station on the earth's surface. At the height of a mile in the free air the temperature is usually from 15 degs. to 25 degs. Fahr. colder than at the earth's surface, and there is virtually no change in temperature, the nights being as warm as the days. The only changes are due to the passage of warm and cold waves. During fair weather at this height the days are very damp, and the nights extremely dry. Low clouds frequently cover the earth, and even rain may fall from these while the sun shines bright at the height of a mile. The average velocity of the wind at this height is four times greater than at the ground, and hurricanes of 100 miles an hour are not uncommon. At least, the meteorograph records obtained by kites, and measurements of the heights and movements of clouds with theodolites, indicate that these are the conditions which exist above Blue Hill."

The latest idea from America is to fly kites from the summit of Mount Rainier, the highest mountain in the United States. With a start of over 14,000 ft., it is expected that an enormous altitude will be attained. Still, we should have been inclined to think that, considering the expense and trouble of getting to

Digitized by Google

the summit of this great mountain, better results might be more easily obtained direct from the ground. Even if kites cannot be got up to so great a height, balloons certainly could get much higher.

GORDON'S SOARING MACHINE.

A new soaring machine, somewhat similar in general design to that of Lilienthal, has lately been tried by Mr. N. R. Gordon. The wind, however, was unfavourable on the first day of trial, so that no very satisfactory results were obtained. Mr. Gordon hopes, however, to make further experiments during the summer. The spread of wing of the machine is 37 ft. 6 ins., and the average width about 5 ft. It is strongly made with piano steel wire bracings to the wings, and weighs 70 lbs.

A GUNPOWDER MOTOR.

The "New York Herald" gives a description of a new engine actuated by the explosion of gunpowder. The engine described is for application to a bicycle, which it is said to be able to drive for 100 miles on end. As, however, no details are given of its actual performance, its practical success seems, at present, not to be fully proved. The engine weighs 8¾ lb. The cylinder, 3 ins. long and 1 in. in diameter. The exploding chamber is 2 ins. long, 1½ ins. high, and 1¾ ins. wide. Above the cylinder is the powder magazine, 4 ins. diameter and 2 ins. deep. The explosion of the powder generates a "gaseous smoke," which acts much the same as steam in a steam engine. The gunpowder is conveyed from the magazine to the exploding chamber by means of an automatic feeder.

METEOROLOGICAL FORECASTS.

The report of the Meteorological Council to the Royal Society for the year ending March 31, 1896, has just been issued. The forecasts are prepared three times a day, at 11 a.m., 3.30 p.m., and 8.30 p.m. They are available for the information of anyone who applies for them at the office. As regards the correctness of the forecasts, 55 per cent. proved completely successful, 25 per cent. partially so; so that the total percentage of successes was 80. The average of success for the years 1886-95 was 81.5 per cent. The amount voted by Parliament for these services during the year was £15,300.

NEW PROJECTS FOR AERIAL NAVIGATION.

A beautiful picture of Davidson's "Air-Car as it will appear when completed," has been sent us, but, as the prospectus says, "this drawing does not show the detail," and until we know more of it, we shall be unable to feel any confidence as to its eventual success.

A glowing account, plentifully illustrated, is given in the "Philadelphia Engineer" of a machine invented by Mr. C. E. Hite, of Philadelphia. It appears, however, to be at present only a small model, which is driven along suspended from a wire. The idea seems to be nothing more novel than that of a sausage-shaped balloon, propelled by fans, to be driven by a 35 horse-power steam engine.

Another somewhat similar design by Mr. H. C. Robertson figures in a later number of the same journal.

Yet another wild idea is pictured and described in an American paper. Whether the original design is more practical we cannot say, but according to this account Mr. Skobeloff, a Russian "naval expert" at Vladivostock, has designed a machine consisting of three cylinders of aluminium, the largest of which is 18 ft. long and 8 ft. diameter, filled with gas. Below sits the man working the propeller, *a la* bicycle. It seems almost superfluous to point out that this volume of gas would not be capable of lifting more than about 70 lbs.

SOME NOVEL IDEAS ON ARTIFICIAL FLIGHT.

We have received several long letters from Mr. T. G. Challis, from which we extract a few of the most interesting items, many of which are really original. This gentleman is evidently an authority on the subject, to quote his *own words*. "I began on this Problem of aerial flight just 35 years ago this coming summer, and studied and worked allmost incessentionlly for 33 years that is I got over the last difficulty that of ballancing the machine in the air with safety on the morning of June the 4th, 1895 exactly 33 years after I began the first stroke i am very well aware that you will have some difficulty in believeing this statement I can hardly expect you to do so without some little proof of some kind or other—but still as far as you can take my unerforced word i can asure you that what i say is the truth absolutely the truth—you may take it that i should not take upon myself the terrible Responsibility of declareing before the World that i had solved the Problem of aerial flight if i had not realy done so." Later on he gives a truism often forgotten:—"before you can hope to do this you must make yourself well acquainted with the principles," and says, "you must keep studying the mechanical action of the natural flying machine the Bird till you fairly Recognise how the whole thing is done this is quite open to you have as many lessons as you like all is free dame nature unlike mecreny man gives splendid lessons free." He then states:—"I venture to say this invention will be full of supprises especialy to the scien-

tific world but the most suppriseing supprise of all will most undoubtedly be the supprise that anything so extremely simple was not seen long before." Speaking of artificial flight, he says:—"it is destined to come all things point to this end we can not stand still even if we wished it." But here comes a really novel reason for the desirability of a flying machine: "The air is destined to be the great highway of the worlds commerce in the future because the Land will be wanted for a more important purpose namely that of growing food for the teemenng millions that will by and bye inhabet the earth curious enugh just as Stephensons invention of the Railway and Locomotive engine Robed mankind of millions of acres of fertile Land so will the invention of the Fairy Carraige of the future the flying machine restore this Land back to its right purpose that of growing food." Then comes a point on which we certainly beg to differ with this unassuming authority: "It is very difficult for me or any one else to say but I should gess that the speed of the first practical and safe flying machine would be from two to four miles an hour it most certainly will not be very fast." We think it will; however, our correspondent is encouraging when he tells us, "I consider traveling in the air will be in time to come about the saftest mode of travel as well as the plesentest." We hope it will be so. Mr. Challis then takes us rather into his confidence when he describes the trial machine which he proposes to build: "It will be constructed in a very fancifull stile with the true design disguised as much as Possible for Reasons you will understand" (which, however, we don't) "as I have designed it it will be a spendid looking afair in fact it will be more to please the eye more than for any other purpose" (this we can quite believe) "this you will understand will be in Reatily the first practical flying machine ever constructed in the world's history." "Praps," he says, "you will be a little supprised when I tell you that I have not a single drawing or a moddell of any kind," but adds, "but this does not matter in the least." He ends up the long correspondence—which, by the way, we shall be happy to show to anyone interested in it—by saying: "A great industry will follow this (invention) that will be in time to come so vast and farreaching in its proportions that the Great Railway industry of the world gigantic as it is will pale before it as the morning star Pales before the radiant riseing sun."

Recent Publications.

Kite Experiments at the Weather Bureau (United States), by Prof. Marvin, is a reprint of articles which have appeared in the "Monthly Weather Review," beginning April, 1896.

In November, 1895, Prof. W. Moore, the chief of the Weather Bureau, directed the author to consider the subject of kites and auxiliary apparatus for the meteorological exploration of the upper air. The result is that Prof. Marvin has conducted a most interesting and useful investigation in scientific kite flying, and the book forms what is probably the first work devoted to the subject.

Dr. Andrew Wilson, of Glasgow, seems to have been one of the first to apply kites to meteorological purposes, and an account of his experiments in 1749 are recounted. Mr. Birt in 1847 flew a kite at Kew Observatory for obtaining measures of the temperature, humidity, etc., of the air. Mr. Douglas Archibald's experiments in 1883 are then referred to, and those of Mr. Eddy in the United States in 1890. After mentioning the experiments of Mr. A. L. Rotch, at Blue Hill, of Mr. Hargrave in Australia, and others, the author describes the first attempts at the Weather Bureau.

Professor Marvin insists on the importance of applying scientific principles in the construction of the apparatus, instancing the slow development of the steam engine, which became built up piece by piece, and took nearly 200 years to become an efficient machine. Electric generators, on the other hand, of which "all the principal elements of their theory had been fully developed before the devices were invented," attained the highest state of perfection within a few years.

There has always been an uncertainty with kite flyers as to whether it is best to employ one big kite, or several small ones in tandem. The writer points out that "the tension on the string varies greatly when only one kite is flying, owing to the tumultuous and ever-changing character of the wind. These variations are very much less with two in tandem 200 or 300 feet apart. With a tandem of several kites the strain is naturally still more nearly constant;" but later on he adds, "Yet the gain in steadiness when more than two or three kites are employed is entirely unimportant, and a large kite is more effective than an equal surface in small kites."

The first experiments were made with "Malay" kites. These are formed of a four-

sided piece of stuff or paper stretched on a framework consisting of two sticks of about equal length, crossing one another at a point, say, a quarter of the length from the top of the upright stick, the cross stick being bowed backwards. "The general conclusion, however, is that single-plane kites are believed to be less reliable than kites of the cellular type." The latter, though heavier in construction, being much steadier in strong winds.

As regards the theory of kite flying, Prof. Marvin points out that there are five independent forces to be considered. Not only have we to take into account (1) the pressure of the wind on the kite surface, (2) the attraction of gravity, and (3) the tension of the string, but also (4) the attraction of gravity for the string, and (5) the wind pressure on the string. The two last, though not of much importance when the strings are short, become very necessary of consideration when miles of line have to be lifted to the skies.

The analysis of the forces acting on the kite is carefully gone into, and diagrams given to show the direction and amount of the resultant pressure. The lift, increasing with the strength of the wind and the lightness of the kite, and the drift, consisting of the horizontal action of the wind, augmented by the skin friction and by the pressure on the front edges of the kite, combined, are opposed by the pull of the string.

We are inclined to think that Prof. Marvin takes, perhaps, rather too much account of gravity as a condition of importance to be considered. Though, of course, in a very light wind, its influence may be considerable, still, a kite weighing, say, 5 lbs., will usually show a pull on its line of some 50 lbs., and often as much as three times that amount. But then, on the other hand, most of the kites used by him seem to have been very heavy ones.

The position of the centre of pressure is gone into; also the effect of arched surfaces. Another important consideration is the lateral stability of the kite, and the effect of the bending back of the lateral wing surfaces so as to form a dihedral angle. The result of an increase in wind pressure is discussed, and the use of the usual form of bridle shown.

One of the greatest difficulties that a kite-flyer has to contend with is the variability of the wind force. The author points out that the force of the wind at 30 miles an hour is fully nine times as great as at 10 miles per hour.

The tests and methods of testing the lines and other portions of the apparatus are interesting. A table is given, showing the relative strengths and weights of various strings and wire. Steel piano wire is, of course, shown to be the most suitable; aluminium wire being, considering its small tensile strength, the worst. The method of joining steel wire presents a practical difficulty, but is best accomplished by twisting the ends together, "the wires being evenly and uniformly twisted each about a common axis," and not one twisted round the other. The joining of hempen cords is also carefully gone into. As is (or should be) well known, almost every knot forms a weak point in a string. But from a number of trials, Prof. Marvin found that a "bowline" was by far the strongest knot; indeed, the average of 10 tests shows the breaking strain to be greater with such knots than without! But this, of course, can only be accounted for either by the chance of having selected some stronger pieces for the knotted specimens, or that the method of holding the unknotted cord was not quite efficient. The writer makes no mention, however, of splices, which, though perhaps dimcult to make, are probably more satisfactory than any knots.

Descriptions are given of the methods of eye-splicing the wires, of reeling in the lines, and measuring their lengths and tension.

Illustrations are given of some 15 different forms of cellular kites, and no less than 36 kinds are described. We can only state shortly that the effective sustaining surfaces of these varied from 6 to 45 sq. ft., the weight per sq. ft. being about .05 to .07 lb.

The strengths and weights of various materials for kite construction are carefully gone into.

The "catenary," or curve of the retaining line, is treated of from a mathematical point of view.

Altogether this little work forms a most com-

plete account of kite flying from a scientific and practical point of view, and it will form a text-book of the greatest value to the kite-flyer.

Foreign Periodicals.

L'Aérophile (Paris) for January-February commences with a short account, by M. W. de Fouvielle, of "M. Berthelot and his Connection with Scientific Aeronautics." Then follows the "Speech of M. Janssen," delivered at the banquet of the aeronauts of the Siege of Paris, which was held in December last. The speaker, it may be remembered, escaped from Paris in a balloon, in order to observe an eclipse of the sun in Algeria. A detailed illustrated description by M. Hermite of the balloon and instruments sent up from Paris in connection with the "International Ascents" for the exploration of the high regions (referred to elsewhere) is given, also short accounts of the other balloons sent up on that occasion. Proceedings of the "Commission Scientifique d'Aérostation." Viscompte Decazes continues his elaborate "Theory of the Dynamic Soaring." M. G. Garcia gives an account of an "Aerial Voyage by Stages."

L'Aéronaute (Paris). The January number has an article by M. Leopold Desmarest, on the "Last Experiment but One of Otto Lilienthal," chiefly consisting of a translation from the "Boston Transcript." The author of the article points out that during the time Lilienthal used an apparatus with a single plane he never came to grief, and that, though superposed planes give a greater surface with less spread, there is a greater difficulty in the balance when the centre of gravity is low. Moreover, in a machine subject to the variable gusts of wind, it is especially important to have a good control of the balance.

The issue for February contains an account extracted from the *Illustrirte Zeitung* of "Stentzel's Wing Machine" (of which we gave a short account in our last issue). The writer points out that this machine does not in reality resemble so much the apparatus of Lilienthal as the models made some years ago by M. de Villeneuve and by M. Pénaud. The machine is suspended from a horizontal wire, along which it travels propelled by the beats of the wings. Mr. Stentzel intends building a larger machine. The "Bill for the Encouragement of Aerial Navigation," brought before Congress in the United States in 1895, forms the subject of an article by Mr. James Means. Reports of the meetings of the Societé Française de Navigation Aérienne follow.

The March number commences with a translation of the "Funeral Oration on Otto Lilienthal," delivered by Dr. K. Mullenhoff in Berlin, the remainder of the journal being taken up with accounts of the proceedings of the Society, which include many interesting announcements, mostly culled from the periodicals.

Notable Articles.

(*Jan., Feb., March.*)

Engineering, Jan. 1.—Detailed Description of "Cellular Kite." By L. HARGRAVE (*vide page* 9).

Scientific American, Jan. 23.—Illustrated Description of "Dr. Wardwell's Folding Kite."

Nature, Jan. 22.—Letter from S. E. Peal on "Flight of Birds."

Engineer (Philadelphia).—"Mr. Hite's Device for a Navigable Balloon." Illustrated.

Nature, Feb. 25.—Letter from F. W. Headley on "Flight of Gulls."

Cassell's Family Magazine for March.—"With a Camera in the Clouds," by MAURICE FARMAN. An illustrated account of a balloon trip in France with M. Besançon, lasting nearly 18 hours, during which a number of photographs were taken.

Digitized by Google

Daily Graphic, March 23.—"Sounding the Atmosphere." Illustrated account of the international ascents.

In the *United Service Magazine* or April will appear an article on "The Conquest of the Air," by Capt. BADEN-POWELL.

In the *Strand Magazine* for June will appear an article on "Aerial Photography," by Mr. G. FITZGERALD.

Applications for Patents.

770. Jan. 11, 1897. R. M. BALSTON, 46, Lincoln's Inn Fields. **Improvements in Flying Machines.**

1273. Jan 18, 1897. JAMES MURRIE, 12, Houldsworth, Street, Glasgow. **Improvements in Aerial Navigable Vessels and Apparatus in connection therewith.**

2351. Jan. 29, 1897. J. D. WHITE, Fairfield, Redhill, Surrey. **Improvements in Flying Machines.**

3608. Feb. 10, 1897. F. W. LANCHESTER, 18, Southampton Buildings. **Improvements in Aerial Machines.**

5116. Feb. 25, 1897. F. VOLDERAUER and M. I. F. BRACKEBUSCH, 28, Southampton Buildings, W.C. **Improved Apparatus for Enabling Captive Balloons to Travel along a Fixed Line of Rail.**

5150. Feb. 25, 1897. A. QUENTIN, 111, Hatton Garden, E.C. **Improvements in or Relating to Flying or Soaring Machines.**

5354. Feb. 27, 1897. H. H. LAKE, 45, Southampton Buildings (from EDMOND ANGELOT, France). **An Improved Wheel for Propelling or Steering Ships and Aerostats.**

5580. March 2, 1897. A. J. BOULT, 111, Hatton Garden (from FRITZ JONE, Germany). **Improvements in or Relating to Aerial or Flying Machines or Vessels.**

5591. March 2, 1897. ROBERT SCOTT, 11, Baron Street, Pentonville Road. **Improvements in Regulating the Altitudes of Aerial Bodies.**

5739. March 4, 1897. E. N. MOLESWORTH-HEPWORTH, 5, John Dalton Street, Manchester. **Improvements in Flying Machines.**

6320. March 10, 1897. F. R. SIMMS, 4, South Street, Finsbury. **Improvements in Flying Machines.**

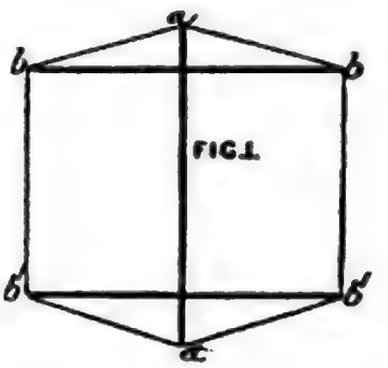
6672. March 13, 1897. A. A. FRIS, 53, Chancery Lane, London. **Apparatus for Aerial Navigation.**

7012. March 17, 1897. RUDOLPH DIESEL, 28, Southampton Buildings, London. **Improvements in Supplying Electrical Energy to Electrically Propelled Aerial Machines and Balloons.**

Patents Published.

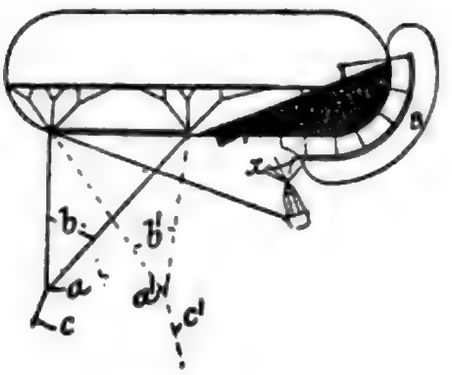
From the *Illustrated Official Journal.*

17,683. September 23, 1895. **Kites.** BADEN-POWELL, B. F. S., Guards' Club, London.



The frame consists essentially of three main poles, two of which b, b^1 are arranged at right angles to the third pole a, as shown. The poles b, b^1 may be attached to the pole a by stays, or the frame may be held together by the cambric of the kite, which is provided with pockets to receive the ends of the poles. The fabric of the kite is either hexagonal or rectangular in shape.

18,773. October 7, 1895. **Captive balloons.** RIEDINGER, A., Ausburg, Eisenhammerstrasse 23, Germany.



The balloon is elongated, and one side is kept towards the end by having small balloons or a crescent shaped one B at the other end. The part opposed to the wind is kept inflated by making an opening x in the other end towards the wind and through which it enters. To the holding down ropes c, c^1 are attached pulleys a, a^1 through which pass cords b, b^1 which are attached to other cords as shown.

18,148. October 8, 1895. **Balloons.** COOK, T. D., Glendon, Torquay.

The aerostat is made fish-shaped and is strengthened by a horizontal band C, to which the netting F is attached, so that the aerostat may serve as a parachute in case it bursts. A wooden cane, or similar rigid framework B tends to strengthen the aerostat and distend it in case of collapse. G is the car and H the motor chamber; there are two propellers D at the rear and a rudder E in front of the machine.

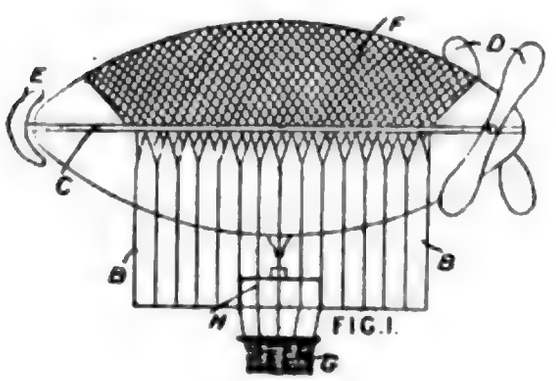


FIG. 1.

19,234. October 14, 1895. **Flying machine.** MIDDLETON, H., 3, Wellesley Villas, Wellington Street, Slough, Buckinghamshire.

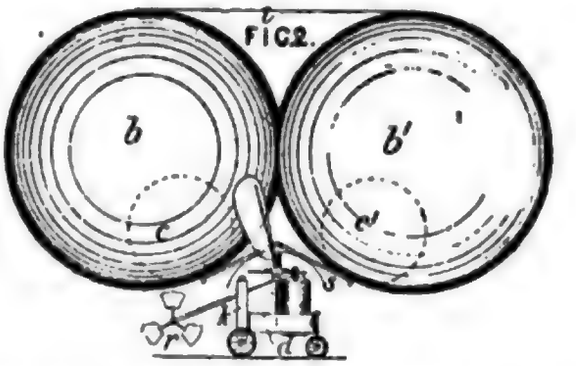


FIG 2.

The car d and motor are supported by two aerostats b, b^1, which are drawn against each other by an elastic connection i and are thus prevented from becoming flaccid; this is further effected by placing inside, as at c, c^1, or partly surrounding the base of the aerostats smaller vessels, which act as condensers for the steam from the motor, the density of the gas in b, b^1 being controlled by regulating the admission of the steam to the condensers c, c^1 and to the condenser k on the car. The heat from the engine is screened from the aerostats by a shield s which is made large enough to act as a parachute in case the aerostats should be injured, when the car and shield can be readily disconnected from them. Steering is effected by a propeller r which may be worked from the engine at will, and the plane of which may be varied by hand. The apparatus is propelled by wings driven by a motor in the manner described in some of Applicant's prior Specifications, as Specification No. 13,945, A.D. 1888, and the wings may be turned by hand so that they will make a stroke in any desired direction.

19,370. October 15, 1895. **Overhead railways.** JENSEN, P., 77, Chancery Lane, London.—(*Bock E.; Bangkok, Siam.*)

Vehicles on overhead railways are partly supported by balloons. The overhead structure consists of posts M, cross girders d, and ropes or rails S on which the vehicle runs and is guided. The balloon B is in compartments attached to the top of the vehicle V, which is propelled by a suitable motor and provided with guide and running wheels as shown. Sails t are attached to the side of the balloon

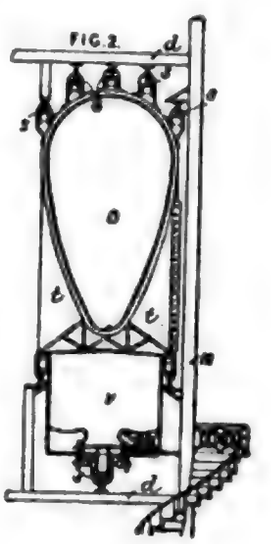


FIG 2.

French Patents.—Published 1896.

252,919. Jan. 2. PENNINGTON. Aerial Ship.

253,175. Jan. 16. BERGER. Apparatus for Directing Balloons.

253,705. Feb. 4. TOTH. Flying Apparatus

253,831. Feb. 10. LUDVIG. Dynamic Flying Machine.

254,194. Feb. 26. GRANIERI. Dirigible Aerial Apparatus to Replace Balloons.

254,307. Feb. 27. TRICOTEL and BECOURT. Improvements in Aerial Apparatus.

254,222. Feb. 29. FILIPPI. Aerial Apparatus.

254,507. March 4. HERVÉ.

255,717. April 21. KOSCH. Aerial Propeller.

257,683. June 30. DHEUTTE. Dirigible Balloon.

257,853. July 6. DIESEL. Transmission of Current to Electric Air Ships.

258,837. Aug. 11. ERAY. Dirigible Balloon.

United States Patents.

Quarter ending Dec. 31, 1896. *Nil.*

German Patents.

PUBLISHED 1897. (Class 77.)

89,859. W. DANIELS, Rheinberg.

Method of Causing a Balloon to Rise and Fall by means of an Air Pump and Two Vessels into which the Gas is Compressed or from which it is Exhausted.

89,860. RUDOLPH KOSCH. Combined Screw Propeller and Aeroplane. (See English Patent, 1896—9129.)

GRANTED.

91,887. E. EGGERT, Siemon Str. 11, Berlin Balloon of Stiff Material with Flexible Balloon Inside.

"USEFUL DESIGNS."

69,055. G. G. MANDER. Kite—Tail with Cross-pieces. (See English Patent, 1896—16,799.)

APPLICATION.

March 10. HERMANN ISRAEL, Schönfelde Str. 15, Dresden. Flying Machine with Bird like Wings.

Digitized by Google



Revue Mensuelle

ILLUSTRÉE

DE

l'Aéronautique

Et des Sciences qui s'y rattachent.

Publiée avec la collaboration des principaux savants français et étrangers.

Directeurs :

Georges BESANÇON et Wilfrid de FONVIELLE.

L'Aérophile, qui comte cinq années d'existence, a des correspondants dans le monde entier.

L'Aérophile est le plus important, le plus répandu, le mieux informé et le mieux illustré de tous les journaux similaires.

L'Aérophile s'adresse à tous les amis du progrès, même à ceux, et nous osons dire surtout à ceux, que l'étude, pourtant si attrayante, de la navigation aérienne n'a pas encore conquis.

Prix du numéro, UN franc.

ABONNEMENTS : France, un an, 10 fr. ; Union postale, un an, 12 fr.

Rédaction et Administration : — 14, Rue des Grandes-Carrières, PARIS.

Téléphone 503-24.



Etablissement Central d'Aerostation.

Ascensions et Constructions Aéronautiques.

Ballons Captifs à' Vapeur.

—: Excursions Aériennes pour Amateurs. :—

Matériel Spécial pour l'Aérostation Militaire.

Lever des Plans Topographiques.

Exploration de la Haute Atmosphère :—

—: Observations Météorologiques, etc.

Georges BESANCON, Directeur,

14, RUE DES GRANDES-CARRIERES, PARIS.

Adresse Télégraphique :—BESANCON, Aéronaute, Paris. Telephone No. 503.24.

120.5
245

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF MIC
AUG 4 191

THE AERONAUTICAL JOURNAL



No. 3. JULY, 1897. Vol. I.

Contents.

	PAGE.
Notices of The Aeronautical Society	1
Flight and Flying Machines. Major J. D. Fullerton, R.E.	1
Langley's Flying Machine. *Illustrated*	9
How to Advance the Science of Aeronautics. V. E Johnson, M.A...	13
The Fatal Accident to Dr. Wölfert's Balloon	14
Hargrave's Motor and Propeller. *Illustrated*	15
Andrée's Polar Balloon	16
Notes: Count Zeppelin's Balloon—The "Turbinia's" Light Engines—Boomerangs—Firing Shells to High Altitudes—Accident in a Balloon—Kites for Meteorological Investigations—Speed of Flying Geese—Pilcher's Soaring Machine—Barnard's Air-Ship—International Balloon Ascents	16
Recent Publications	18
Foreign Aeronautical Publications	18
Notable Articles	19
Applications for Patents—Patents Published—Foreign Patents ..	20

LONDON:

Published by the Aeronautical Society of Great Britain, and Printed by King, Sell, & Railton, Ltd., 12, Gough Square, 4, Bolt Court, and 4, Birchin Lane, E.C.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JULY, 1897.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 8s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd.,
4, Bolt Court, 12, Gough Square,
and 4, Birchin Lane, E.C.

ADVERTISING TERMS:—10/- Per Inch, Single Column.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on June 10th.

The following gentlemen were elected Members of the Society—

COLONEL H. ELSDALE, R.E.

MR. JOHN MARSHALL.

MR. W. G. D. GOFF.

MR. LAWRANCE HARGRAVE.

MR. THOMAS MACDONALD.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Flight and Flying Machines—Recent Progress.

As considerable progress has been made in solving the problem of flight during the past few years, a short account of the present condition of affairs may be of interest.

For convenience sake the subject will be divided into the following sections:—(1) The air and its relation to flight. (2) The methods of measuring the air force. (3) The forces acting on a body in flight, and the conditions of equilibrium. (4) The stability of flying bodies. (5) The power required for flight. (6) The flight of birds and insects. (7) The principles of propulsion. (8) Fuel. (9) Motors. (10) Materials for construction. (11) Design of flying machines. (12) The flying machine in peace. (13) The flying machine in time of war.

(1) THE AIR, AND ITS RELATION TO FLIGHT.

The general nature of the air, its composition, motions, etc., have long been known, but it is only recently that the part played by it in flight has been realized.

Briefly, it may be said that the functions of the air as regards flight are two, viz., to supply a force which will support the weight of the body, and to furnish a force which, when combined with that applied to the propelling instrument, will overcome the resistance to the forward motion of the body. For instance, in the Maxim flying machine, the vertical component of the total air pressure forms the supporting force, while the force applied to the propellers, combined with the re-action of the air, furnishes the power required to overcome the horizontal component, and drive the machine along.

As regards the air itself the principal point to notice about it is its changeableness. Not only the strength of the air force, but also its direction and point of application, are subject to very rapid changes. For instance, in even moderate gales, great changes take place in the force of the wind, while at almost any time the friction of the air against the rough surface of the earth causes the direction of the air currents to vary very considerably. Again, at the equator, the heat of the sun forms vertical currents which materially assist birds in certain kinds of flight, while even in a horizontal wind the angle at which a flat plane is placed causes very great variations in the position of the centre of pressure, or point of application of the air force.

It is evident, therefore, that an accurate knowledge of the action of the air under varying circumstances is of the highest importance, and

(2) THE METHOD OF MEASURING THE AIR FORCE

will now be described. First of all, as to what is meant by the air force. Suppose a plane one square foot in area ($1' \times 1'$) inclined at an angle of 30°, to be driven horizontally through the air; then it will be found that the air pressure on the upper side of the plane is less than the air pressure on the lower side, and that

Digitized by Google

consequently there will be a resultant air force pressing the plane upwards and backwards. This resultant air force is what we require to know, and in order to measure it, very accurate and careful experiments have to be carried out.

Speaking generally, it may be said that there are two ways of testing air pressure, viz., the "Open Air Method" and the "Still Air Method." In the former the body, the effect of air upon which it is desired to test, is fixed in suitable apparatus, and exposed to the action of the wind. Accurate recording apparatus is then employed to find the point of application, direction, and magnitude, of the air force under different circumstances, and thus the effect of the air on the body in question is found. In the "Still Air Method" the body to be tested is made to travel in a straight or circular path in still air, and the necessary measurements taken, as explained above. The great objection to the former method is the difficulty of obtaining accurate results, owing to the constant changes of the wind's direction, and most experimenters are now in favour of carrying out experiments by the second method, which gives better results, though requiring larger and more expensive apparatus. A very complete description of the "Still Air Method" of working is given in "Experiments on Aerodynamics," by Prof. Langley, of the Smithsonian Inst., U.S.A.

As regards the results of experiments, the following is a brief summary of the most satisfactory ones to the present date:—

Centre of Pressure, or Point of Application of the Air Force.

(*a*) *Flat Planes.*—Position varies considerably with the angle the plane makes with its path. If angle = 90° C. of P. is at centre of surface; when the angle is small, say 5° or so, the C. of P. is about ¼ of the length of the surface from the front edge.

(*b*) *Curved Surfaces.*—With small surfaces, having a curvature of $\frac{1}{12}$, the C. of P. remains nearly constant in position, viz., at about ⅓ of the length from the front edge for angles between about 0° and 60°. In triangular shaped surfaces, base foremost, the C. of P. coincides nearly with the centre of gravity at angles between 0° and 60°, a very important fact, as will be seen when discussing the flight of birds.

(*c*) *Bodies.*—No very satisfactory results as yet obtained. With what are called "fair shaped" bodies, there is probably very little change of position of the C. of P. at angles between 0° and 60°.

Line of Action of the Air Force.

(*a*) *Flat Planes.*—For an indefinitely thin plane the line of action is perpendicular to the surface; but if the plane has even a small thickness, the line of action varies very considerably from the perpendicular at small angles. The reason of this is that the pressure on the head of the plane (viz., the thickness) is large in comparison with the pressures on the upper and lower surfaces, and consequently the line of action of the resultant air pressure is thrown back from the perpendicular.

(*b*) *Curved Surfaces.*—The position of the line of action in these cases is so variable that it must be found experimentally in order to get satisfactory results.

(*c*) *Bodies.*—Very few results as yet published. With "fair shaped" bodies the line of action is probably nearly perpendicular to the major axis, at angles between 0° and 30°.

Magnitude of the Air Force.

(*a*) *Flat Planes.*—When perpendicular to path of motion, $p = \cdot 00166 V^2 S$ is the formula given by Langley, and this he considers correct to within about 10 per cent. For inclined planes Langley found Duchemin's formula $P = B' \frac{2 \sin \alpha}{1 + \sin^2 \alpha}$ suitable (see Chanute's *Progress in Flying Machines*).

(*b*) *Curved Surfaces.*—The best results published are those given by Lilienthal (see *Der Vogel flug*), who experimented with wing-shaped surfaces having a $\frac{1}{12}$, $\frac{1}{18}$, etc., curvature. The shape of the surface, and the amount of curvature, affect the pressures so much that experiment is absolutely necessary to get good results.

(*c*) *Bodies.*—Very few results published, but it is quite clear that "fair shaped bodies" immensely reduce the resistance to forward motion; in fact, with some shapes, when moving horizontally, the forward resistance is indefinitely small.

The above are some of the results obtained experimentally with the usual class of testing apparatus, but it appears desirable to draw attention to a theory of the movement of bodies through fluids, called the "Stream Line" theory, which seems to be of great importance in connection with this subject.

When a weightless body of stream line form moves through a frictionless fluid it has been shown by Froude that the resultant air force on it = 0, and that consequently, since no other force acts on it, if it is once put in motion it will move on for ever. Now air is practically frictionless, and the body of a bird is approximately of the stream line form; consequently, supposing its weight to be borne by the wings, this stream line theory shows that the *body* of the bird will, at even high velocities, have only a very small resistance to overcome, and that no very great power *can* be required to propel it. A similar argument applies in the case of the wings of the bird, which are simply slightly curved surfaces, so formed that at any given velocity the vertical component of the air pressure acting on them

Digitized by Google

balances the weight of the bird, while the horizontal component forms a small forward resistance, which together with the small body resistance above described, are the only forces which the bird has to overcome.

It this theory is correct, it will be seen that it explains what has so long puzzled all experimenters, viz., how such a small creature as a bird could apparently exert so much power. The real fact, of course, is that owing to its form, very little power is required, and that consequently the bird is not extraordinarily powerful, as has often been supposed.

Before leaving this part of the subject it is desirable to point out to experimenters the importance of accurately recording the forms and dimensions of the bodies they test, as great differences in results have been obtained, owing to some such matter as the thickness of a surface, etc., not having been taken into account.

(3) The Forces Acting on a Body in Flight and the Conditions of Equilibrium.

There are really only two kinds of flight, viz., "Driving Flight" and "Soaring Flight," the former being exemplified by a bird moving along flapping its wings, the latter by the soaring birds, which move along on motionless wings.

In driving flight three forces act upon the body, viz., the air (at rest or in motion), the weight, and the driving force, and it is evident that in order to keep the machine in any particular path and move it with a constant velocity, the following conditions must be fulfilled:—

1st. The forces perpendicular to the path must = 0.

2nd. The forces along the path must = 0.

3rd. All the forces must act through the centre of gravity of the machine.

As will be seen further on, the great difficulty in designing a machine is to insure the centre of pressure, or point of action of the air force, always coinciding with the centre of gravity, there being of course no difficulty in making the other two forces act through the same point.

Next, as regards "Soaring Flight," similar rules hold good, but in this case there is no artificial driving force, and consequently the propelling force must be got by suitably combining the other two in such a manner that their resultant always acts in a forward direction.

This is done either by altering the inclination of the sustaining surface, or by using a rudder to steer the machine up and down in a vertical plane, precisely as a ship's rudder moves it to right or left in a horizontal plane.

In still air a body cannot be made to rise above its original level by soaring flight, but when the air is in motion it seems possible, by suitable steering (viz., taking proper advantage of the wind), to attain any level, and to continue the motion of the machine indefinitely.

Soaring flight is of the greatest importance; partly because it is steadily practised by certain kinds of birds, but chiefly because it shows how safe alighting (the most difficult act of flight) can be accomplished. By steering as above explained, a machine can be brought to the ground with little or no vertical velocity (the first consideration), while as regards horizontal velocity, this can always be made a minimum by designing the machine in a suitable manner.

(4) The Stability of Flying Bodies.

The next point to consider is how to ensure the "stability" of a flying body. By "stability" is meant the power which a machine or body must possess of always righting itself if temporarily displaced from its normal position by a force which tends to overturn it. For example, suppose a sudden change in the direction of the wind from, say, the horizontal, to −60 ; this will at once cause a change not only in the direction of the air force acting on a body, but also in its point of application, and consequently, if the body is badly designed, may overturn it.

Next, as regards the different classes of stability. It is evident that the body must be stable in all three planes, viz., the horizontal plane, the vertical longitudinal plane, and the vertical transverse plane, the planes being taken as passing through the centre of gravity of the body and its path.

As regards the horizontal plane, stability cannot be automatic; some kind of rudder or steering apparatus must be used. In the marine ship a vertical rudder or twin screws are found suitable, and for the aerial ship the arrangements will be similar.

In the vertical longitudinal plane stability must be automatic, that is to say, if the air ship is temporarily moved out of its normal position, it must return to it as soon as the moving force has ceased to act. To ensure this the centre of gravity of the body should be kept well below the centre of pressure of the sustainer.

In the vertical transverse plane stability must also be automatic, and this can be arranged for as explained for the vertical longitudinal plane.

The question of stability is of the highest importance; probably 90 per cent. of the failures in attempts at flight have been due to the neglect of the study of this part of the subject.

Digitized by Google

(5) The Power Required for Flight.

The power required for flight has usually been very much over-estimated; for instance, in the case of birds some most absurd calculations have been worked out, giving the power exerted by them as many hundred times greater than its real value.

As explained above, there are really only two kinds of flight, viz., soaring flight and driving flight, and it is desirable to consider them separately.

In soaring flight, the only forces acting on the body are its weight and the air; no artificial force acts on it; and flight of this class is based solely upon skilfully combining the weight and air forces. As a consequence, no artificial force whatever, or, in other words, no power, is required for soaring flight, and provided the wind (or air force) is suitable, and proper arrangements are made for combining it with the force of the weight, there is nothing to prevent this class of flight being carried on indefinitely without any artificial aid whatever.

In driving flight the conditions are different. Here two forces have to be developed, viz., the sustaining and the driving force. The most suitable way of doing this seems to be to use either a large sustaining surface, as done by Maxim, or to construct the machine on the lines of Phillips, and use a large number of small surfaces, something like the slats of a Venetian blind. Then, in order to sustain the body in a horizontal path, and drive it along with constant velocity—

Sustaining force (vertical component of the air force) = Weight = W,
Driving force = Horizontal component of the air force = K,

and the power required to drive and sustain the body at constant velocity V

$$= \frac{KV}{550} \text{ H.P.},$$

using the ordinary units of measurement.

Of course, in order to vary the velocity, the movement of the mass must be taken into consideration, as would be done in the case of a body moving along the earth's surface.

(6) The Flight of Birds and Insects.

The flight of birds and insects has always been of the greatest interest to aviators, but it is only of late years that the true principles of their movements have been discovered. The bird or insect is a true flying machine—the wings forming the sustainer and propelling instrument, the body corresponds to a car, the feet are the rising and alighting apparatus, while the food is of course the fuel which, so to speak, drives the engine (the muscles of the wings).

As regards the bird, a great deal of information as to size, dimensions, weight, etc., is available, owing to the researches of Mouillard, Chanute and others, and the following details are of interest, as they give some sort of idea of the probable dimensions of the flying machines of the future:—

Sustaining Surface.—The weight carried per square foot of wing surface of some of the principal birds is a follows:—

Swallow	.276 lbs.
Gull	.436 ,,
Rook	.575 ,,
Duck	1.158 ,,

(See "Progress in Flying Machines") (Chanute).

Motors, viz., pectoral muscles = from $\frac{1}{4}$ to $\frac{1}{3}$ of the total weight of the bird.

Power Developed.—Penaud gives the following:—

Peacock . .	1 H.P. per 66 lbs.	per total weight.
Pigeon . . .	1 H.P. per 57 lbs.	
Sparrow . .	1 H.P. per 48½ lbs.	

For a gull Chanute gives 82½ lbs., but this is probably an over-estimate, as the body resistance was taken rather high.

It is interesting to notice that the Maxim flying machine was required to develop about 1 H.P. for every 50 lbs. of the total weight of machine fully loaded.

The different flight manœuvres of birds may now be briefly described.

Starting.—There are two modes of starting, viz., running along the ground, flapping the wings and jumping into the air, and springing into the air from a perch. The former is much the hardest work, and some of the heavier birds have great difficulty in carrying it out; in fact, many of them do not come down to the ground level at all if they can avoid it.

A flying machine will have to start somewhat after the first method, and will as is easily understood, have to exert its greatest power at that time.

Turning in the Air.—To effect this the bird raises its wing, on the side to which it desires to turn, and also inclines its weight slightly to that side.

Gliding.—This form of flight is often mistaken for "soaring," because the bird holds out its motionless wings exactly as it does in the latter kind of flight. What really happens is that the unexpended energy ($\frac{1}{2}mV^2$) is utilized, usually to glide down a gentle slope of about $\frac{1}{10}$ or so, though it is possible for the bird to rise above its original position by increasing the angle of inclination of its wings.

Soaring has been explained above; it depends merely on the skilful combination of the air and weight forces. It may be noticed here that, according to Lilienthal, when a soaring bird holds its wings out horizontally, the line of action of the air force lies in front of a vertical line through the centre of pres-

Digitized by Google

sure, and consequently there is a *forward resultant* force, which drives the bird along. Further experiments on this point are much required.

Hovering.—In this case the bird faces the wind, holds its body nearly vertical and remains still in the air, except that it beats its wings more or less vertically up and down. This manœuvre requires a good deal of exertion, and can only be performed in a high wind.

Alighting.—This is done by ceasing to flap the wings, inclining the body nearly vertically, and spreading the wings out at a steep angle of inclination. When the ground is reached the bird usually runs a few steps, so as to destroy its horizontal velocity. Flying machines will alight upon very much the same principle; they will be steered to the earth as explained above, and then stopped by the friction of the ground on their landing wheels.

The flight of insects is not so important as that of birds, as it is often very irregular and not suited for flying machines. There is also considerable difficulty in obtaining satisfactory data as to the power exerted by insects, owing to their small size and delicate construction, which do not allow of accurate measurements. Lucy has, however, made some researches into this branch of the subject, and ascertained for a few insects, the ratio of weight to surface, etc. (See Chanute's "Progress in Flying Machines.")

(7) The Principles of Propulsion.

In order to provide the "Driving Force" which gives the forward and sustaining motions in "Driving Flight," it is necessary to use some form of propelling instrument so constructed as to act upon the air surrounding the body or flying machine, and thus furnish the propelling force.

Before, however, discussing propellers, it is desirable to point out that the form and shape of the flying machine may, if badly designed, have a very injurious effect on the propelling instrument. For example, a marine ship with a square stern almost always gives unsatisfactory results, because the screw blades work in disturbed water, and the full value of the propeller thrust is not obtained. In air ships, it is to be hoped, defective forms will be avoided, and the propellers so placed that they will work in undisturbed air, which is much the most satisfactory plan. The loss of power by a badly-formed ship can only be found experimentally.

As regards the propellers themselves, there are three which are usually considered, viz., the jet, paddle, and screw, and they all act upon the same principle, viz., a certain mass of air, water, etc., is driven astern per second of time with a certain velocity, and the thrust or driving force = mass × velocity (Rankine's rule).

The jet and paddle propellers are not suited for aerial work, because the first requires a very large amount of material to work it, while the second is very unwieldy and awkward to construct and operate.

The screw propeller can be made in two forms, the wing type, viz., that used by the birds, and the rotary type, used in marine propulsion.

As regards the wing type, it is very difficult to say whether it is more efficient than the marine type because wings are used to support as well as to propel, but this class has one objection which seems to be fatal to its use in flying machines, viz., that should the actuating apparatus of the wings get out of order, disaster is almost certain to occur, owing to the alteration of the form of the wings, which it must be recollected have *to support* as well as drive the body.

Probably, therefore, the well-known marine type of screw-propeller will be found the most satisfactory for aerial work, as, if it is broken or damaged, the safety of the air ship will not be affected.

As regards the marine type, it is not intended here to describe its action, but one point may be noticed, which does not seem to have been considered hitherto. The blades are, so to speak, flying surfaces required to move with a certain speed over a fixed path; and consequently if, by testing the blades as described for surfaces, in a still or open air apparatus as explained above, we find the power required to drive them, the line of action of the air force, etc., it would seem to be comparatively easy to find with very fair accuracy the power required to work the propeller.

In marine engineering great difficulty has always been found in estimating the power of propellers, because Rankine's rule, given above, is extremely difficult to apply. It is impossible to find out how much water is driven astern or what the velocity of the water really is; consequently no satisfactory results can be obtained by calculation. But with the air propeller, matters will be much easier, as there is no difficulty about testing the blades, and a very good estimate of the driving power required for any given propeller can then be got.

(8) Fuel.

In order to provide the "Driving Force" fuel or material, capable of giving out heat (or in other words, work), is necessary. Such fuel must be safe, have a good heat capacity, and be convenient to handle.

The fuels in common use are: coal in its various forms, oil, explosives, and materials for making electricity.

Coal in its solid form is the commonest kind of fuel; it is safe, and has a fair heat capacity (12,000 B.T.U.), but, on the other hand, it is awkward to handle and stow, and its heat

capacity is a good deal less than that of petroleum oil.

The gaseous form of coal gives very good working results in suitable engines, but it has one great objection, viz., that it must be compressed for stowage, and this consequently quite unfits it for use in flying machines.

Coal dust, or some of the patent fuels seem to be very promising forms of fuel, as they have most of the advantages of coal, and are much more convenient to handle and store (see Diesel engine).

Next, as regards petroleum, there are three kinds which are generally used, but only one, the medium oil, with a specific gravity of ·8, flashing point 73° F., and heat capacity 20,000 B.T.U. per lb., appears to be really safe for aeronautical work. This kind of oil is used a great deal in oil engines, and gives very satisfactory results; the only objection to it for war being its liability to catch fire if struck by an exploding shell.

Explosives have always been a very favourite form of fuel with inventors. Unfortunately, however, they have great disadvantages; in the first place, there is always a risk in handling them; and in the second place they are not nearly so efficient from the heat (and consequently power) point of view as is popularly imagined. A pound of coal and a pound of gunpowder, *when supplied with oxygen necessary for combustion*, give out about the same quantity of heat (or power). But in the case of the gunpowder the oxygen forms part of the powder, while with the coal the oxygen is obtained from the air, free gratis, so to speak, and consequently with the latter there is a saving in weight, owing to no oxygen having to be carried. Hence, until some alteration can be made in the condition of explosives, it seems unlikely that they will be useful for working motors.

As regards electricity, there is no doubt that the materials used at present are far too heavy in proportion to their capacity for work to be of any use for aeronautical work. Some good results have been obtained on a small scale with coal by Borchers and others, but nothing really satisfactory for general work is obtainable at present.

(9) Motors.

As explained above, the fuel supplies the power required for propulsion; the motor is a machine devised to utilise the power to the best possible advantage. It cannot be said that at present there are any very good motors in existence; the best of them does not utilize 30 per cent. of the heat of the fuel, and the remaining 70 per cent. is not only lost, but is chiefly expended in more or less damaging the motor itself. Moreover, with the present system of working there does not seem much possibility of any really satisfactory improvement, as the waste of power is due to circumstances largely beyond our control. For instance, in a gas or oil engine, about 35 per cent. of the heat of the fuel is wasted in the exhaust, and this cannot well be much reduced owing to the difficulty of reducing the exhaust temperature below the ordinary temperature of the air. Again, the loss of heat to the water jacket of a gas engine can only be improved by using a very much higher piston speed, an arrangement which is, practically speaking impossible, on account of the mechanical difficulties in constructing pistons and cylinders capable of bearing such largely increased strains. Taking, however, the principal well-known motors, the following may be considered as more or less suitable for aeronautical work. Steam or vapour engines, gas and oil engines, electrical motors and a new form of engine called the "Diesel," which works on an entirely novel principle.

Steam and Vapour Engines.—The ordinary marine type of steam engine gives fairly good results, about 1¼ lbs. of coal being required per hour for one H.P.; the weight of the motor is, however, very great, viz., from about 200 lbs. per H.P. for ordinary steamers to about 60 to 40 lbs. for torpedo boats, yachts, etc. The Maxim engine, in which petroleum was used for firing and as working fluid, weighed only about 10 lbs. per H.P., all told, which was marvellously little; while the expenditure of fuel was only about .8 lb. petroleum per H.P. per hour. A promising form of rotary engine, designed by Parsons, has, it is understood, given good results in the steamer "Turbinia," but the designer has not yet published his trials.

Gas and Oil Engines.—Up to the present a gas engine seems to hold the record for efficiency, as one quoted by Clerk (see "Proceedings of Institution, C.E., 1896), had an efficiency of 27.5. But the difficulty of stowing the gas will always be against this kind of engine, and it is not likely to be used for aeronautical work.

The oil engines, on the other hand, promise well; they are very nearly as efficient, and some of them, like the Kane-Pennington, are very light.

The Kane-Pennington appears to be a very good motor of its class, as it is powerful, light, and does not require a water jacket. This latter is a matter of the highest importance, as the ordinary gas or oil engine requires a very large amount of cooling water, and the re-cooling of this water, after it has left the water-jacket, is one of the great difficulties in connection with this type of engine. No doubt the water can be cooled by passing it through the tubes forming the framework of the flying machine, and taking off some of the heat for warming purposes, but any engine which can work without a water-jacket will most undoubtedly be far more convenient for aerial work.

Another good motor is the Loyal, which also works without a water jacket, and seems to

Digitized by Google

be extraordinarily economical, its efficiency being apparently about 40 per cent. But in this case, as with the Kane-Pennington motor, accurate trials and experiments are much required to give the exact amounts of power generated.

Electrical Motors.—The electrical motor is the ideal one for aeronautical work, but the methods of generating electricity are not at all satisfactory at present. If a dynamo and steam motor is used, it is obvious that the final efficiency will be less than that of the steam engine, so that this form of motor is quite out of the question.

The battery form, whether primary or secondary, is also unsuitable, on account of the very great weight of the materials required, and it cannot be said at present that there is any reasonable chance of a good electrical motor being found for aeronautical work.

The Diesel Engine.—A new form of engine is at present being worked out by the inventor, Herr Diesel, the peculiarity of which is that its system of work is quite different to that employed in any existing engine. According to Herr Diesel, all heat engines at present in use work on a wrong principle, because they supply too much heat to the working fluid, and supply it at the wrong time.

According to his theory, the following are the fundamental conditions for the successful working of any heat engine:—

1st. The highest temperature of combustion should be produced by highly compressing the working fluid (air).

2nd. The combustible coal, oil, etc., should be introduced into the mass of highly compressed and heated air during part of the return stroke of the piston; no increase of temperature taking place. After ignition, combustion should not be left to itself, but arranged so as to maintain the right proportion between the pressures, volumes, and temperatures.

3rd. The proper proportion of air and combustible should be used so as to limit the maximum compression temperature, and thus enable the engine to work without a water jacket. The experimental engine now being tested works between the limits 800° C. and 130° C., and the inventor hopes to get an efficiency of about 60 per cent. (see the *Rational Heat Motor*, by R. Diesel, translated into English by B. Donkin).

Before leaving the subject of motors, it is desirable to touch on two important points, viz., "the efficiency of engines," and "the weight of engines per H.P.," terms often used in a very casual manner.

By the efficiency of an engine is meant

$$= \frac{\text{useful work}}{\text{total work}}$$

$$= \frac{\text{heat usefully expended}}{\text{total heat the fuel is capable of giving out,}}$$

and no other definition accurately expresses the true efficiency.

By weight of an engine per H.P. is meant

$$= \frac{\left\{\begin{array}{l}\text{The total weight of boiler,}\\ \text{engine, dynamo, con-}\\ \text{densers, etc.,}\end{array}\right\} + \begin{array}{l}\text{Total weight}\\ \text{of fuel for } x\\ \text{hours}\end{array}}{\text{the number of effective or break H.P.}}$$

No standard for x has ever been laid down, but for aeronautical purposes it would be convenient to have some such standard, say, as follows:—

A Standard	...	...	$x = 10$ hours.
B Standard	...	...	$x = 30$ hours.
C Standard	...	...	$x = 50$ hours.

(10) Materials for Construction.

The materials likely to be used for the construction of flying machines are:—Steel, wood, aluminium, silk, canvas, etc.

Steel will be found useful for framework, engines, etc. Tube steel, similar to that used for bicycles and horseless carriage framework, will form the basis of the machine, while steel wire rope should be employed for guys, etc. The engines will also be largely made of steel.

Aluminium is not as strong as steel for its weight, but for parts where no great strain is likely to come may be found useful.

Silk, Canvas, etc., will be required for the surfaces of aeroplanes such as Maxim's, but possibly some form of aluminium wire woven webbing may be found preferable if the cost can be got to within reasonable limits.

Wood.—With the Phillips and Lilienthal types of machine, wood is largely used; in the former for the supporting slats, in the latter for the framework.

Passing now to

(11) The Design of Flying Machines,

the following general notes may be found useful:—

Type.—There are at present three types of machine which seems likely to prove successful, and to distinguish them they will be called after their inventors, viz., the Lilienthal (soaring only), the Maxim, and the Phillips. Numerous pictures of these machines have appeared in the public press of late years, and their general form and construction is well known to aeronauts.

The Lilienthal machine is for "soaring" only, and does not call for much remark, as this kind of flight can never be used for, say, fast passenger traffic, or war purposes.

The Maxim machine consisted of a large kite-like surface, underneath which was hung

a suitable car for carrying passengers, motor, stores, etc. To start, the machine was driven along the ground at a high speed, and on a certain velocity being reached, the air pressure under the aeroplane or surface raised the machine in the air. The machine did rise a little on one occasion, but an accident (which had nothing to do with the aeronautical part of the test) occurred, and prevented further trials.

The Phillips machine has no large sustaining surface, but a number of small ones, and appears to be specially suited for war purposes, as if painted a light grey, or lead colour, it would be, practically speaking, invisible at about 1,000 yards range.

Weights to be Carried.—These are the passengers, war material, stores, etc. It is not possible to lay down any proportion between them at present, but for a small experimental machine the following might be tried:—Passenger, 150 lbs.; machine framework, etc., 120 lbs.; motor and fuel for one hour 80 lbs.; or a total of, say, 350 lbs. to 400 lbs.

Ratio of Sustaining Surface to Weight.—In birds this varies from ½ lb. per square foot to about 2 lbs., probably in this case 1 lb. or 1½ lbs. per square foot would be sufficient.

Dimensions.—These will depend upon the resistances, and power required for driving. Probably, a platform 8 feet by 3 feet will be suitable for the body; it should hang some 8 feet to 10 feet below the sustainer. The latter might have a surface of about 300 square feet, or rather more; this would enable the machine to leave the ground when its velocity = about 20 to 25 miles per hour. A well designed curved surface might, however, be only about 200 square feet in area, and this would be a great advantage.

Power.—By means of models and a whirling table, a very good idea of the power required could be obtained. Probably from 6 to 8 h.p. would suffice in this case.

Detailed Design.—The approximate design having been worked out, the detailed design should now be taken in hand and drawings made of all the different parts, such as framework, sustainer, propellers, etc. An accurate model, exactly to scale in weight as well as dimensions, will be found very useful.

Motor.—The most convenient fuel will be petroleum oil or coal dust. The Diesel type of engine, or Kane-Pennington type, seem to be the most suitable kinds of motor.

Starting and Landing Apparatus.—Light wheels of the bicycle type, but smaller, will possibly be best for this. For a small machine rails, as used by Maxim, are unnecessary. All that is required is a large, smooth, open space where starting and alighting can be conveniently carried out.

Steering Apparatus.—In the horizontal plane a vertical rudder can be used, or one screw propeller run faster than the other. For the vertical plane, fore and aft rudders connected together, so that they can be worked simultaneously from the platform, will be found convenient. The effect of these rudders should be tested by models.

Testing.—This should be done with great care; a calm day being selected for the preliminary tests. The machine should be run along the ground, the fore and aft rudders being so adjusted as to make it rise with the platform (or car) horizontal.

Flights.—A few feet above the ground will be quite sufficient for trial flights, the object being to see how the air affects the machine.

The above remarks only explain generally how the designing and testing of a machine might be carried out; precise methods depend upon the machine. The principal points to attend to are:—

1st. Have a large, smooth, open place to practise in.

2nd. Make quite certain of the "balance" or "stability" of the machine before trying experiments at high speed.

(12) The Flying Machine in Peace.

The principal use of the flying machine in time of peace will be for special commercial work, scientific exploration and amusement. As regards commercial work, fast mail and passenger traffic seem to be the most suitable applications, because high speed can be obtained, and the cost of transit will be comparatively cheap. A very fast machine of the Maxim or Phillips type should be built for £5,000, and probably less; while the cost of wages, fuel, etc., will be small. Landing places, species of "land harbours," will of course be required, but the great advantage over railways will be the saving in the purchase of land for permanent way purposes, and the up-keep of the latter.

As regards scientific exploration, there is no doubt that flying machines will be most useful for geographical work, and also for the exploration of the upper atmosphere.

It is to be hoped, also that, as an amusement, aerial yachting will find followers just as marine yachting does at present.

(13) The Flying Machine in War.

The chief use, however, of the flying machine will be for war purposes, and in the near future an "Aerial Force," like the present "Sea" and "Land" Forces, will be a necessity for all nations.

Future wars will commence with heavy

fighting in the air between the opposing aerial navies, followed by attacks on marine fleets, and concentrated bodies of troops by the conqueror. Marine navies will specially suffer, and among the land forces cavalry, artillery, and all mounted troops will find anything like concentrated action an impossibility.

To sum up:—

1st. In the near future, aerial warfare by swift flying air-ships will revolutionize the present methods of war by sea and land.

2nd. Owing to the high rate of speed of the air-ships, all nations will have to maintain themselves ready for war *at very short notice*.

3rd. The nations most affected by aerial warfare will be those which depend at present for their defence on marine navies.

4th. As aerial ships will be, comparatively speaking, inexpensive, the smaller nations will be able to make use of them.

5th. Owing to the possibility of war at very short notice, a larger proportion of a nation will have to be kept under arms.

6th. Warfare by sea and land, on any extended scale, will only be possible to the nation which has the command of the air.

J. D. FULLERTON, *Major, R.E.*

The Brine Baths Hotel,
Nantwich, Cheshire.

Langley's Flying Machine.

Full accounts have now been published of the interesting experiments conducted by Professor S. P. Langley with his model "Aerodrome." Both the "Strand Magazine" and "McClure's Magazine" give almost identical accounts from the pen of the inventor, while in the "Aeronautical Annual," a somewhat more technical description is given.

These accounts go to show that which is so well understood by many of our readers, the extreme difficulty in the designing and constructing of such an apparatus. His well-known experiments with a whirling table gave the inventor valuable data to work upon, but the question of balance and behaviour in the air had to be studied, and this could hardly be done without constructing a complete working model, yet how could such a model be made until the principal conditions of flight were learned? So it seemed that the inventor was "shut up in a sort of vicious circle."

Having constructed over 30 modifications of rubber-driven models, however, a model was constructed to be propelled by a steam engine, but after many months' work it was found that the weight could not be reduced below forty pounds, while the engine would only develop half a horse power, and finally the model was condemned. A second apparatus, to be worked by compressed air was then tried, but the power proved insufficient. Then came another with carbonic acid gas engines. Then others with various applications of electricity and gas, etc., but the steam engine was found most suitable, yet "it seemed to become more and more doubtful whether it could ever be made sufficiently light, and whether the desired end could be reached at all. The chief obstacle proved to be not with the engines, which were made surprisingly light after sufficient experiment. The great difficulty was to make a boiler of almost no weight which would give steam enough."

At last a more or less satisfactory engine was constructed, but then other difficulties cropped up. To prevent the machine smashing itself against the ground when anything went wrong, it was found best to test it over water. And in order to start it against the wind a kind of house-boat was procured, so that the starting apparatus could be directed to any desired point. But then came the difficulty of giving the apparatus an initial speed, which was deemed necessary to start it.

It was in 1893 that these first trials of the "Aerodrome," launched from the house-boat, were made, but yet the difficulties, the constant failures, the inefficiency of the apparatus were such that three years more of constant work had to be devoted to the machine before a really successful flight had been made.

After very many unsuccessful trials, a good start was made with No. 5 model on May 6th, 1896, a photograph of which was taken (reproduced herewith). The inventor describes it thus:—"For the first time the 'Aerodrome' swept continuously through the air like a living thing, and as second after second passed on the face of the stop-watch, until a minute had gone by, and it still flew on, and as I heard the cheering of the few spectators, I felt that something had been accomplished at last, for never in any part of the world, or in any period, had any machine of man's construction sustained itself in the air before for even half this brief time. Still the 'Aerodrome' went on in a rising course, until, at the end of a minute and a half (for which time only it was provided with water and fuel), it had accomplished a little over half a mile, and now it settled rather than fell into the river with a gentle descent."

In November another model, No. 6, was tried, which went for about three-quarters of a mile at a rate of about 30 miles an hour.

The latest model, as may be seen in our illustration, consists of two pairs of rigid and motionless wings, each slightly curved, attached to a long steel rod, from which depends the body of the machine in which are the boilers, engines, and machinery. Two screw propellers between 3 and 4 ft. in diameter, are placed in rear of the front pair of

Digitized by Google

wings, on each side of the central rod. The front portion of the hull is closed by a sheathing of metal to protect the fire-grate, behind which may be seen the coils of the boiler, and the smoke-stack. The conical vessel in front is a float to keep the apparatus from sinking when it lights in the water. The engine gives a force of 1 to 1½ h.p. The boiler, with its fire-grate, weighs a little over 5 pounds, and the engine, with all its moving parts, but 26 ounces. The propellers revolve at rates varying from 800 to 1000 turns a minute. The rudder, adapted both for vertical and horizontal steering, is placed in rear of all.

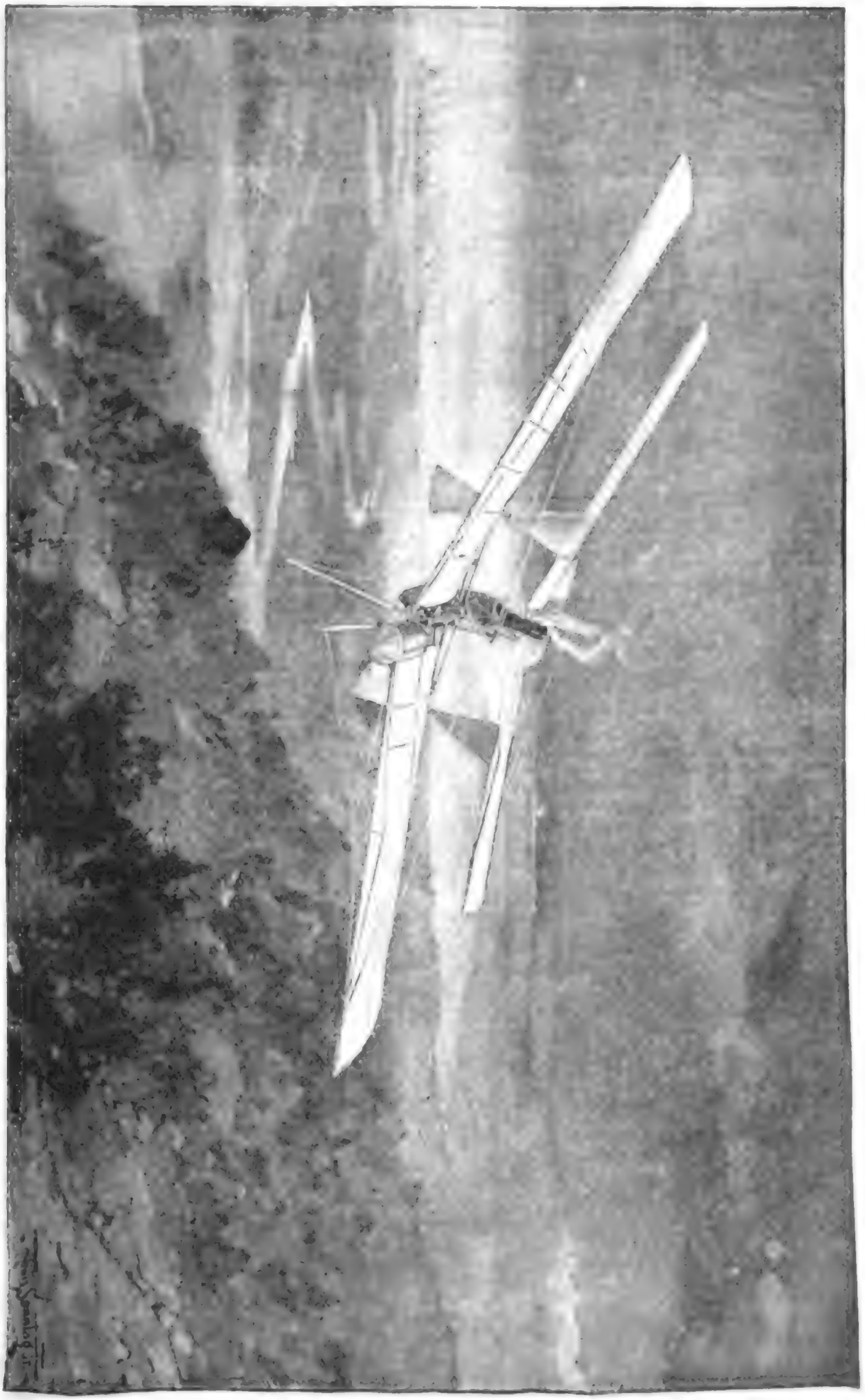
The width of the wings from tip to tip is between 12 and 13 ft., and the length of the whole about 16 ft. The weight is nearly 30 lbs., of which about one-fourth is contained in the machinery. The engine and boiler are constructed so as to economise weight, and are therefore very wasteful of steam, of which they spend their own weight in five minutes. Condensers cannot easily be introduced in so small a scale of construction. The length of flight of this model is therefore very limited, though, if necessary, it could doubtless be greatly prolonged without much difficulty. There are two cylinders, each with a diameter of 1¼ inches. The piston stroke is 2 inches. The two screws, with a pitch of 1¼, are 39



Launching of the "AERODROME."

From the *Strand Magazine*.

Digitized by Google



THE "AERODROME."

From the *Strand Magazine*.

Digitized by Google



THE "AERODROME."

From the *Strand Magazine*.]

Digitized by Google

inches from tip to tip, and revolve in opposite directions.

The boiler consists of a continuous helix of copper tubing, ⅛ inch external diameter, the diameter of the coil being 3 inches altogether. Through the centre of this is driven the blast from an "Elopile," a modification of the naphtha blow-torch used by plumbers, the flame of which is about 2000 F. The pressure of steam issuing into the engines varies from 100 to 150 pounds per square inch. Four pounds of water and about 10 ounces of naphtha are carried. The boiler evaporates about one pound of water per minute.

How to Advance the Science of Aeronautics.

By V. E. Johnson, M.A.

On commencing the study of aeronautics it is above all things most important that we should make ourselves thoroughly acquainted with what has already been accomplished in order to save waste of effort on our part in trying experiments or devices already dealt with. Again, it is quite a mistake to suppose that but little, if anything at all, has as yet been accomplished towards the solution of this—the, perhaps, greatest of all mechanical problems. We do possess at last a *science* of aeronautics, and a preliminary study of this same science is a *sine quâ non*; the successes and failures of the past must be carefully studied, as also the apparent causes of such successes and failures; and the principles involved—that is to say, the aerodynamical principles—must be above all things, most carefully studied, in order that the investigator may be perfectly enabled to distinguish between any inadequate proposal, certain to fail, and a design worthy of consideration, investigation, and, perhaps (after careful thought), a practical trial.

I give therefore, at the end of this article, a list of books, articles, etc., the study of which will make any student of this science quite *au fait* with what has already been accomplished in this subject. The subject—so far as concerns any practical issues, is as yet beyond the scope of mathematical analysis; and, taking into account, the extreme complexity of all atmospherical movements on any practical scale, I venture to say will long continue to be so. Recourse must always be had to experiment and common-sense, which Guizot defined as "the genius of humanity." But they must be experiments conducted on correct scientific lines; mere hap-hazard experiments are useless, if nothing worse. A preliminary scientific training—more particularly on the experimental side—is obviously most useful; and a good sound knowledge of elementary mathematics and mechanics has now become in reality a necessity.

There is no longer any *mystery*, strictly speaking, attached to aeronautics. Even that great stumbling-block to early observers—the sailing and soaring flight of certain birds—has been reduced to perfectly intelligible mechanical laws. It is now possible to construct a motor of such a horse-power and yet possessing such lightness that it is able—by the attachment of suitable apparatus—to sustain itself in a calm atmosphere; to launch itself into the air by means of special appliances, and to alight with safety on some specially prepared or chosen surface.

This, however, is not by any means the complete solution of the problem which requires a machine that will arise or alight vertically (or practically so) in wind or storm, and maintain its equilibrium in the atmosphere under other conditions than the "calm of evening." To elevate a flying machine into the air is one thing; to maintain its equilibrium there under adverse circumstances, is something very different. Electrical and other motors (but the former are preferable in this case) can now be built of such lightness—neglecting, in the case of electricity, the source of electrical energy—that they can, by means of suitable appliances, elevate and maintain themselves in the atmosphere. Much, I think, might be learnt from the behaviour of such, in the form of large models attached to a central axis of rotation, round which they might fly, and through which the electrical energy might be conveyed by means of suitable wires, etc; more especially their behaviour in stormy weather. Kinematographic representations of the same would be invaluable for future reference. Indeed, the kinematograph might be made, in my opinion, to play a by no means unimportant part in the advancement of aeronautics. These models must, however, be of large dimensions for really useful practical data, their aeroplanes being fifteen or twenty feet across at the very least. Any invention which will supply us *per se* with a motor developing more horse-power per pound weight than any yet created will advance this science. Any discovery which will give us a material or substance possessing more strength per unit of weight will do the same; as also will an aeroplane of such a shape as to lift more weight per square foot of surface than any such as yet constructed when travelling through the atmosphere at the same angle of inclination to the horizontal and at the same speed. The same remarks hold true *mutatis mutandis* with respect to aerial screws.

It is obvious that the general configuration of the air ship should be such that it shall move through the air with the minimum of resistance (both lengthways and sideways) *at the speed at which it is intended to drive it*. Experiment in this direction may therefore be not entirely without value.

The following brief list contains, to the best of the writer's knowledge, some of the most important writings that have been published on this subject during recent years.

"Aerial Navigation," Maxim.—"Century Illustrated Monthly." October, 1891.

"Aerial Navigation," Holland.—"Cosmopolitan." November, 1892.

"The Aeroplane," Maxim.— "Cosmopolitan." June, 1892.

"Progress in Aerial Navigation," Maxim.—"Fortnightly Review." October, 1892.

"Experiments in Aerodynamics," Langley.—"Smithsonian Contributions to Knowledge," Washington, 1891. (A brief account by Rayleigh in "Nature," December 3, 1891.)

"The Internal Work of the Wind," Langley.—"Philosophical Magazine." May, 1894.

"Phillip's Aerial Machine." "The Times." May 24th, 1893.

"Professor Langley's Flying Machine."—"English Mechanic." May 12th, 1893.

"Flying Machine Motors and Cellular Kites," Hargrave.—"English Mechanic." November 3rd, 1893.

"Mr. Maxim's Flying Machine."—"The Times," August 3, 1894.

"Aeronautics." (A journal published during 1894. Forney, 47, Cedar Street New York.)—Contains a full account of the proceedings of the Conference on Aerial Navigation, held in Chicago, August 1, 2, 3, 4, 1893. It is without doubt a very valuable publication on the subject.

"Aeronautics," Brewer and Alexander.—(London: Taylor and Sons, Red Lion Court, Fleet Street 1893.)—Contains an abridgement of Aeronautical Specifications filed at the Patent Office from 1815 to 1891. It consists of much that is instructive, not a little that is absurd, and sometimes ideas that are even sad.

"Copies of Mr. Maxim's Patent Specifications," Nos. 16,883, A.D. 1889; 19,228, A.D. 1891; 19,254, A.D. 1892; and 10,852, A.D. 1893, should be obtained from the Patent Office and be carefully studied.

"Progress in Flying Machines," by O. Chanute.—Published by the "American Engineer and Railroad Journal," 47, Cedar Street, New York, and which contains an account of the best work done on the subject up to 1894, together with some able criticisms on the same. Is by far the best and most complete book that I know of on the subject, and should be in the hands of all aeronautical students.

The foregoing list can be supplemented by the one given on page 16 of the new "Aeronautical Journal," to which may be added "Nature," January 30th, 1896. Lilienthal's Experiments on Flying (Illus.).

The Fatal Accident to Dr. Wölfert's Balloon.

It is with extreme regret that we have to chronicle yet another fatality to experimentalists in aerial navigation. Not only do we lament our loss of the lives of two valued confrères, but deplore the failure of the experiment, the calamity which must act so detrimentally to the cause we have in view.

Dr. Wölfert, a man of forty-five years, had for many years devoted himself to the construction of a navigable balloon. In 1884 he made two trials with a cigar-shaped balloon of about 18,000 c. ft., the car of which was rigidly attached to the gas bag. Two screws were worked by man power, and though a deviation from the wind course was gained, no great speed was, of course, attained. He then proposed adding a 5 h.p. motor. Later on he constructed another and larger balloon, which was exhibited at the Berlin Industrial Exhibition last year, and which is the one to which this appalling accident has happened. An illustration and description of this machine appeared in our number for January last. But it had undergone many improvements, including the addition of an aluminium screw, and a benzine motor of 8 h.p. The balloon was about 240 ft. long and 90 ft. diameter.

On June 12th, the apparatus was to undergo trials at the grounds of the Military Balloon Department, in the Tempelhofer Field, near Berlin, where a number of people were assembled to watch the experiment. Dr. Wölfert himself and a mechanic named Knabe got into the car.

The balloon ascended to a height estimated at 2,600 feet, and was steadily progressing against the wind, when something appeared to be wrong. The machine lurched from side to side; a loud report was heard, and then flames shot out, and the balloon became ignited. The car becoming detached fell rapidly to the ground.

The frightfully mutilated and charred remains of the two unfortunate aeronauts fell into a neighbouring timber-yard. It was evident that death had closely followed the fiery explosion.

It is supposed that the cause of this disaster was owing to the aeronaut omitting to turn off the flame before opening the lower valve of the balloon, which was situated immediately above the motor, though the report heard would rather point to its being due to an actual explosion of the benzine engine. On the other hand, it had been noticed before the balloon left the ground that the flame of the benzine motor on several occasions shot out to a considerable height, and apprehension was expressed as to the safety of the venture.

Digitized by Google

Hargrave's Motor & Propeller.

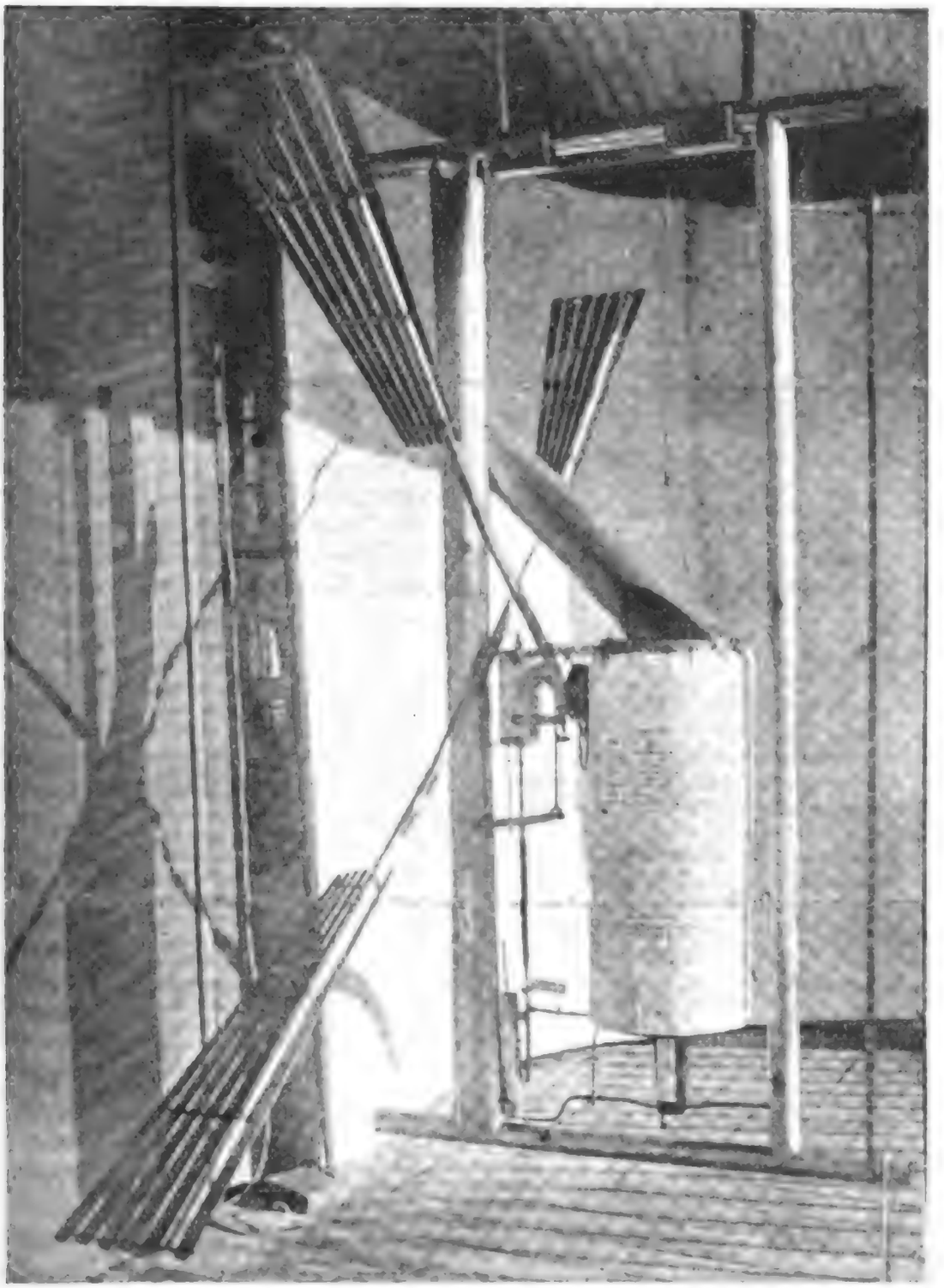
The illustration shows Mr. Hargrave's latest device of a motor for a flying machine (February, 1897). The engine appears to work well, the "fire being very steady" and "the boiler supplies plenty of dry steam." The propellers, moved up and down with a feathering action, "produce a steady thrust in the line of the wing axes," but, as yet, the amount of thrust obtained is not satisfactory.

The boiler consists of 124 ft. 6 ins. of 5-16 in. copper pipe; outside surface, 10.27 sq. ft.; content, 88.4 c. in.; weight of pipe, 8 37 lbs.; coiled, 8½ ins. outside diameter; upper 2-3rds of pipe branches into 2 parts, joining again at the steam-pipe.

The weight of the motor complete (without water or kerosene), 35½ lbs. The retort is made of 7 ft. 6 in. of ¼-in. copper pipe.

The kerosene fuel is stored in the long upright tube on the right of the picture, the water in the larger tube to the left.

The engine cylinder is 2½ in. diameter, and 5 in. stroke. An air or kerosene pump is placed at the lower left hand.



HARGRAVE'S MOTOR.

Digitized by Google

Andrée's Polar Balloon.

It is possible that the bold aeronaut, M. Andrée, may at this moment be hovering in mid air over the Pole, for he arrived at Spitzbergen on May 30th, firmly resolved to again attempt the journey in his balloon. The balloon house, though it had suffered greatly from the wintry storms, has been repaired, and the inflation of the balloon commenced on June 18th, so that it should be ready some five weeks earlier than last year.

Dr. Eckholm, who is said not to consider the balloon sufficiently strong or capacious for its work, has not accompanied the expedition, so that the voyagers will consist of MM. Andrée, Strindberg, and Fränkel, while Lieut. Swedenborg has accompanied them in order to go in the balloon should it be possible or desirable.

The arrangements are practically the same as last year, but the balloon has been increased in capacity by 300 c. metres by the insertion of an equatorial band, so that it is now about 140,000 c. feet, with a lifting power of over 9,000 lbs.

The loss of gas during the period it was inflated last year gas found to be about 2,000 c. feet a day. But M. Andrée allows for a loss of 3,000 c. feet, under which circumstances the balloon could remain in the air for six weeks. Four months' supply of food is to be taken in the car.

The drag ropes are calculated to retard the speed to the extent of 25 per cent. less than that of the wind, and to keep the balloon at an average height of about 840 ft.

With an average speed of 16 miles an hour, the Pole should be reached in 42 hours from the start. But it is the journey back to inhabited lands that is so uncertain and problematical.

It is proposed to drop from time to time messages enclosed in spherical buoys of cork, with a flag attached. By this means it is hoped that should the expedition come to grief, some record of their progress may, at all events, come to hand.

Special stores have been sent to Franz Josef Land by the "Windward" in case of the explorers finding themselves in that neighbourhood.

Believing as we do that through the air is the only sure road to the Pole, we wish the gallant voyagers all success and a safe return!

NOTES.

COUNT ZEPPELIN'S BALLOON.

The *Financial News* announces that "An interesting company is being formed at Stuttgart, under the title of the Gesellschaft zur Forderung der Luft-Schiffahrt. With a capital of 1,000,000 marks, this company will endeavour to realise the prospect of governable aerostation in conformity with the plans of Count Zeppelin. Large blocks of shares are stated to have been applied for by serious persons who believe in the future of the company." It may be added that the Count, who is a German cavalry officer, has for years been studying the question of navigable balloons, and has several times brought forward his proposals.

THE "TURBINIA'S" LIGHT ENGINES.

This experimental launch, fitted with a steam-turbine engine designed by the Hon. C. Parsons, has lately beaten all records by travelling at a speed of 34 knots an hour. According to *Nature*, "the weights are remarkable, and certainly have never before been equalled for lightness in any practical marine machinery." The total weight of machinery, boiler, screws and shafting, tanks, &c., is 22 tons, and the horse power developed 1576. This would give 71 horse power per ton, or 31 lbs. per horse power.

BOOMERANGS.

Mr. G. T. Walker has communicated to the Royal Society (March 15th), some Notes on this curious aerial toy. In the specimen described, the "arms" are twisted through about 4° in the same manner as the blades of a right-handed screw propeller. The theoretical action is discussed.

FIRING SHELLS TO HIGH ALTITUDES.

Some interesting experiments have recently been conducted at the Lydd Artillery Camp. Some heavy guns were placed in an almost upright position, and the shells were projected to a height of 3,600 ft.

ACCIDENT IN A BALLOON.

During the Yorkshire Gala, Mr. Percival Spencer made a balloon ascent, accompanied by five gentlemen. On descending, near Driffield, the car bumped heavily on the

Digitized by Google

ground, with the result that one of the passengers, Mr. G. C. Lee, broke his leg, though how the accident happened exactly cannot be explained.

KITES FOR METEOROLOGICAL INVESTIGATIONS.

A paper by Mr. A. L. Rotch, of the Blue Hill Observatory, Mass., was read before the Royal Meteorological Society on April 21st, describing the experiments conducted at that Institution with Kites. *Nature* (June 24th) says :

"The United States Weather Bureau has been conducting experiments with kites flown at distances of from one to two miles above the earth, and now it is claimed that it is possible to forecast the weather for a period of sixteen hours longer than at present, and more accurately. It is said that the fact has been established, that shifting of the wind occurs at the height of a mile above the earth's surface from twelve to sixteen hours before the same change of direction occurs on the surface. Researches by means of high-flown kites and aeroplanes have now been prosecuted so far as to warrant the expectation that, within six months, the United States Weather Bureau will be able to construct a telegraphic synchronous chart, based on conditions of the atmosphere, one mile above the earth. This chart will cover the region between the Rockies and the Alleghanies at the outset."

SPEED OF FLYING GEESE.

Some more observations have been made by Mr. H. Helm Clayton, at the Blue Hill Observatory, determining accurately the height and velocity of the flight of a flock of geese migrating northward. So rapid is the velocity of flight that the flock was visible to the observers (who were engaged in measuring cloud velocities with theodolites) only about two minutes ; but, during that time, two sets of measurements were taken. The calculations gave the height as 905 ft. above the ground, and the velocity of flight as 44·3 miles an hour. The direction of flight was from the S.W., the wind at the time being from W.N.W., with a velocity of 8 miles an hour.

PILCHER'S SOARING MACHINE.

Mr. Pilcher recently conducted some more trials with his apparatus at Eynsford. In this, the wing surface is about 23 ft. from tip to tip, spreading some 180 sq. ft. of area. A long rope was attached to the machine, which was hauled along so as to start it like a kite, and a very successful flight of about 150 yds was made.

BARNARD'S AIR-SHIP.

An ascent was made recently at Nashville, Tennessee, by Mr. A. W. Barnard, in a cylindrical balloon, 42 ft. long by 16 ft. diameter. A beam was suspended some 10 ft. below by netting, and to this was attached a saddle and pedals, like those of a bicycle, geared to a four-bladed screw propeller. The balloon was inflated with hydrogen, and rose to a height of 500 ft., and it is calculated that the aeronaut was able to drive it at a rate of 10 or 12 miles an hour across the wind, and was able to steer it round in a circle A descent was made about 4 miles off. Some of the daily papers have commented upon this news with a tone of incredulity ; but, after all, there is nothing very remarkable in the achievement, though we might be inclined to think that the stated speed was somewhat exaggerated.

THE INTERNATIONAL BALLOON ASCENTS.

The following results were obtained by the simultaneous ascents on 13th May last.

Paris. Registering balloon "L'Aerophile I." went across the Alps and descended at Novara, having attained a height of 50,000 ft. "L'Aerophile II." descended at Dicy, height 22,000 ft. "L'Aerophile III." fell at Egreuil.

Berlin. Balloon with Dr. Berson ascended 20,000 ft. ; rough landing near Stolpe in Pomerania. Another balloon with Herr Siegsfeld and a register balloon also ascended.

Strasburg. Balloon with Dr. Hergesell and Lieut. Baron 9,100 ft., landed near Feldberges.

Register balloon "Langenburg" came down near Wolfach in Schwarzwald. Register balloon "Strassburg" attained an altitude of 32,500, descended after 13 hours in Fichtelgebirge.

St. Petersburg. Balloon "Wannowsky," height 9,000 ft., landed near Wiborg, Finland. Register balloon reached 36,000 ft.

Recent Publications.

"*The Aeronautical Annual*, 1897." Edited by J. Means (Boston, U.S.A.). London: W. Wesley & Son. 5s.

It is with much satisfaction that we welcome the third number of this very well-got-up annual, which this year is of especial interest.

Full accounts are given of Prof. Langley's latest experiments, an excellent portrait of the inventor forming the frontispiece. Some most interesting and profusely illustrated accounts are given by Mr. Chanute and by Mr. Herring of their experiments in gliding flight on the shores of Lake Michigan. It seems almost unnecessary for us to refer further to these experiments, since everyone interested in this subject ought certainly to obtain a copy of the annual and make a careful study of it.

We may just mention that from a number of machines experimented with, one with superposed and narrow aerocurves was found the most efficient, and that the best flight lasted for 14 seconds and covered a distance of 359 feet. A translation of Herr Müllenhoff's address on the death of Otto Lilienthal, embellished by a portrait of the unfortunate enthusiast, is followed by three papers by him, "Our Teachers in Sailing Flight," "At Rhinow," and "The Best Shape for Wings."

Mr. Chanute continues his most valuable contribution on "Sailing Flight," begun in the Aeronautical Annual No. 2. Mr. Huffaker writes on "The Way of an Eagle in the Air." Short articles by Mr. Maxim on "Screw Propellers Working in Air," and by Mr. Pilcher on "Gliding Experiments," are followed by a number of interesting notes under the head of "Miscellany" and several pithy articles headed "Editorial."

Altogether we can strongly recommend this book to our readers as one which is absolutely indispensable to anyone making a proper study of the question of aerial navigation.

"*On obtaining Meteorological Records in the Upper Air by means of Kites and Balloons*," by A. Lawrence Rotch, is published in pamphlet form by the American Academy of Arts and Sciences (Vol. XXXII., No. 13). The author begins by saying that "a knowledge of the physical conditions which prevail up to the highest cloud levels, five to nine miles above the earth, is of great importance to meteorologists," and points out that observations on mountains do not give what is required. Balloon ascents with observers are expensive and somewhat dangerous, while captive balloons are limited to lower altitudes and are blown down by wind, so that unmanned balloons and kites are alone suitable for the purpose. The Blue Hill experiments, of which we have given accounts, have proved the utility of the latter method up to 9,000 ft., and the "ballons sondes" recently sent up from Paris and from Berlin and elsewhere to heights up to 60,000 ft have proved how satisfactorily the former method can be employed.

Foreign Aeronautical Periodicals.

L'Aéronaute (Paris) for April. "Second International Ascent of 'l'Aerophile'," "On the Apparatus Employed" and "Observations," written respectively by Messrs. Hermite and Besançon, L. Cailletet, and A. Muntz. Proceedings of the Société Française de Navigation Aérienne include memoir of M Bretonnière and his observations on bird flight, and other matters. May, "On the Variation of the Electric State of the High Regions of the Atmosphere," by G. le Cadet. "On the Equation of the Aeroplane," by Vicomte Decazes. Proceedings of the Society, including a life of the late Mr. Brearey, experiments by M. Ricour, conducted in 1885, on the resistance of the air. Description of an apparatus for aerial propulsion by the reaction of the deflagration of mixed gases. A review of Capt. von Parseval's paper on kite balloons.

June. "On a Graphic Criterion Applic-

able to Flying Apparatus," by Capt. Marcotte. Announcement of the offer of two prizes of 1,000 francs each for a motor of 50 kilos. (1 cwt.) per horse-power, and for a study of the coefficients necessary for calculations for an aerial machine. Vicomte Decazis gives some calculations relative to aeroplanes.

L'Aérophile (Paris) for April May. Life of Mr. Glaisher, with portrait, designating him "the grand old man" of aerial navigation. Observations of the seventh ascent of "L'Aerophile" Preparations for the Polar Expedition of M. Andrée. Military ballooning in Denmark (illustrated). "Theory of Dynamic Soaring," by Vicomte Decazes (continued). "Navigation Aérhydrique" (continued). Atmospheric electricity. Aeronautics at the Congress of the "Sociétes Savantes" at la Sorbonne. Scientific Commission of Aerostation of Paris. Researches on rarified gases. Obituary (P. de Jouvencil and Henri Widmer). Review of aeronautical publications.

La France Aérienne (Paris), 1—15 April: "The Discovery of Balloons," refutation of the Brazilian and Portuguese Legends; Equilibrium in Dirigible Balloons; "New Flying Machine" (Stenzel's); and other interesting notes. 15—30 April: "Study of the High Regions of the Air;" "Lilienthal;" "An Aerial Voyage," Raymond de Montmoreney. 1—15 May: "An Aerial Voyage" (continued), and notes. 15—31 May: "Congress of the Sociétés Savantes," with designs for navigable balloon; "Eray's Navigable Balloon" (illustrated); "The Bordeaux Society of Aerial Navigation;" Notes on the History of Ballooning, &c. 1—15 June: "An Aerial Voyage;" "Macedoine;" Notes. 15—30 June: "Captive Balloon at the Leipsig Exhibition," giving details of the first month's working. Notes.

Reveil de France (Paris) is a new weekly paper devoted to certain subjects, including "Aerostation." The first number (2nd May) contains an article on "The Aeronautical Situation."

L'Aeronauta (Milan), Jan.—Mar.: "Liquid Carbonic Acid Motors," with illustration of Stenzel's engine; "The Dominion of the Air;" "Animal and Mechanical Flight;" "Compressed Air Turbines;" "Metallic Balloons," as designed by Lana, Dupuis-Delcourt, Marey-Monge, and Fontana; "Arrigo's Lenticular Balloon;" "Exploration of the High Regions of the Air;" Notes. April—May: "The Lenticular Balloon" of Sig. F. Arrigo (illustrated);" "Metallic Balloons;" "Employment of Explosives as a Motive Force;" "The Theory of Aerial Navigation," by Captain F. Biazzi; "Books and Journals."

Zeitschrift für Luftschiffahrt (Berlin). April. "The Simultaneous Scientific Balloon Ascents of 14th November," giving details of the results obtained. "Experiments with Large Air Propellers," by Prof. G. Wellner (illustrated), an interesting scientific paper. "Experiments on Wind Pressures," by F. Ritter.

Reports of the Upper-Rhine Aeronautical Society. This Society continues to prosper. The membership now amounts to 254. Particulars are given of the Society's new balloon, also the results of the international ascents of 13th May.

Notable Articles.

(*April, May, and June.*)

United Service Magazine, April.—"The Conquest of the Air," by Capt. BADEN-POWELL. This article, though palpably written some years ago, may still be considered as embodying the general status of aerial navigation. It is divided in three parts, headed respectively—"Aviation and Flying Machines," "Ballooning," and "Aerial Warfare." Summarizing shortly what has been accomplished, and what is likely to result from the introduction of any kind of steerable air-craft.

Alte and Neue Welt, April.—"Ballooning." (Illustrated.)

Philadelphia Record, April 3.—"Balloons." International Scientific Ascents.

Sketch, April 7.—Davidson's Flying Machine. (Illustrated.)

Invention, April 10.—"The Aeronautical Society."

Spectator, April 17.—Scientific Kite Flying.—Review of Woglom's "Para Kites."

Army and Navy Gazette, April 17.—"Kites for War Purposes."

Invention, April 24.—"The Mysterious Air Ship."

Black and White, April 24.—"Ballooning," with portraits of Messrs. SPENCER.

Century Magazine, May.—"Scientific Kite Flying," J. B. MILLET (Illustrated); "Experiments with Kites," Lt. H. D. WISE (Illustrated); "Photographing from Kites," W. A. EDDY (Illustrated). These three articles form a most interesting account of what is being done in America with Kites, though the achievements of experimenters in other parts of the world are entirely ignored.

Revue Maritime, May.—"Aerial Currents: Their Course and their Uses for Balloonists." (Cont.)

Spectator, May 1.—"Scientific Kite Flying." Letter from Mr. ARCHIBALD.

Daily Mail, May 3.—"A New Engine of War—Capt. BADEN-POWELL'S War Kite."

English Mechanic, May 14.—"Aerial Navigation." Historical.

Cleveland Leader (U.S.A.), May 16.—"International attempts to solve the problem of Aerial Navigation." (Illustrated.)

Sheffield Weekly Telegraph, May 28.—"Kites in Warfare."

Invention, May 29.—"Aerial Flight."

Toronto Daily Mail, May 29.—"A Great Balloonist." Prof. ANDREE and Polar Ballooning

The Strand Magazine, June.—"The New Flying Machine," Prof. LANGLEY. (Illustrated.)

McClure's Magazine, June.—"The New Flying Machine," Prof. LANGLEY. (Illustrated.)

The Rambler, June.—"Our War Balloons." (Illustrated.)

Rocket, June 17.—"Adventures in the Air." The Fates of some Aeronauts.

English Mechanic, June 18.—"Our Teachers in Sailing Flight," O. LILIENTHAL. Reprinted from Aeronautical Annual.

Golden Penny, June 26.—"About Flying Machines." (Illustrated). Historical.

Pall Mall Gazette, June 29.—"A New Experiment in Soaring Flight."

—◆◆◆—

Applications for Patents.

9734. April 16. JOHN MARSHALL, 23, Rockingham Terrace, Birdwell, Barnsley. **An Improved Method of Construction and Application of Wings and Aeroplanes and Appliances Connected therewith for the Purpose of Aerial Navigation.**

9864. April 20. BERNHARD REINARD BEENEN, 89, Chancery Lane. **Improvements in Flying Machines.**

10,620. April 28. HIRAM STEVENS MAXIM, 45, Southampton Buildings. **Improvements in Aerial or Flying Machines.**

10,811. April 30. GUSTAV FRICKE, 18, Southampton Buildings, London. **Improvements in Aerial Balloons.**

13,372. May 31. OCTAVE CHANUTE, 70, Market Street, Manchester. **Improvements in and Relating to Flying Machines.**

13,743. FREDERICK WILLIAM BENNETT, 12, Hawthorne Grove, Penge. **Improved Machine for Flying.**

14,078. June 9. HENRY JOHN CHART, 4, South Street, Finsbury. **Improvements in the Propulsion of Boats and other Vessels, Flying Machines, and the like.**

14,334. June 12. HENRY JENNER DUFFERIN, 33, Chancery Lane. **The Space Traveller, or Self-Lifting Vehicle.**

15,135. June 24. GEORGE CAMERON DOUGLAS, 41, Reform Street, Dundee. (W. H. BLAKENEY, South Africa.) **Improvements in Aeronautic Apparatus.**

15,221. June 25. THOMAS MOY, 8, Quality Court, London. (O. CHANUTE and A. M. HERRING, United States.) **Improvements in or Relating to Means or Appliances for Effecting Aerial Navigation.**

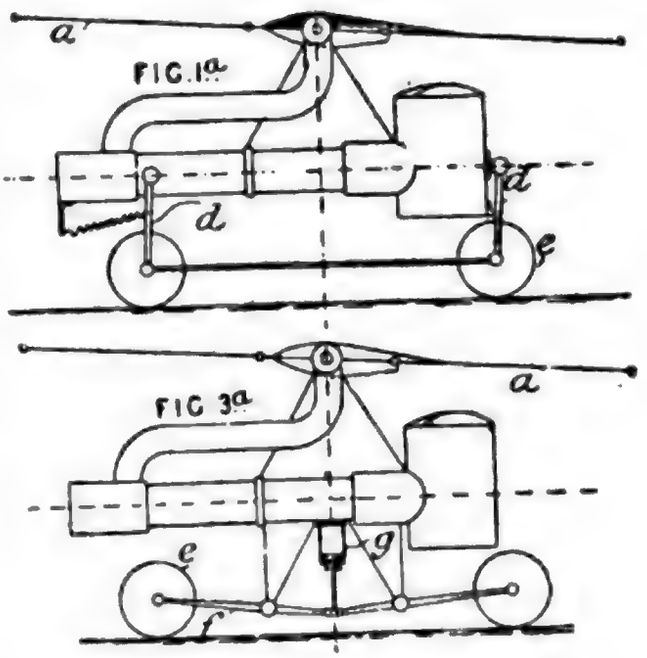
15,278. June 26. WILLIAM CHARLES CHITTY ERSKINE, 27, Southampton Buildings, London. **Improvements in the Method of or Means for Aerial Signalling.**

Patents Published.

From the *Illustrated Official Journal.*

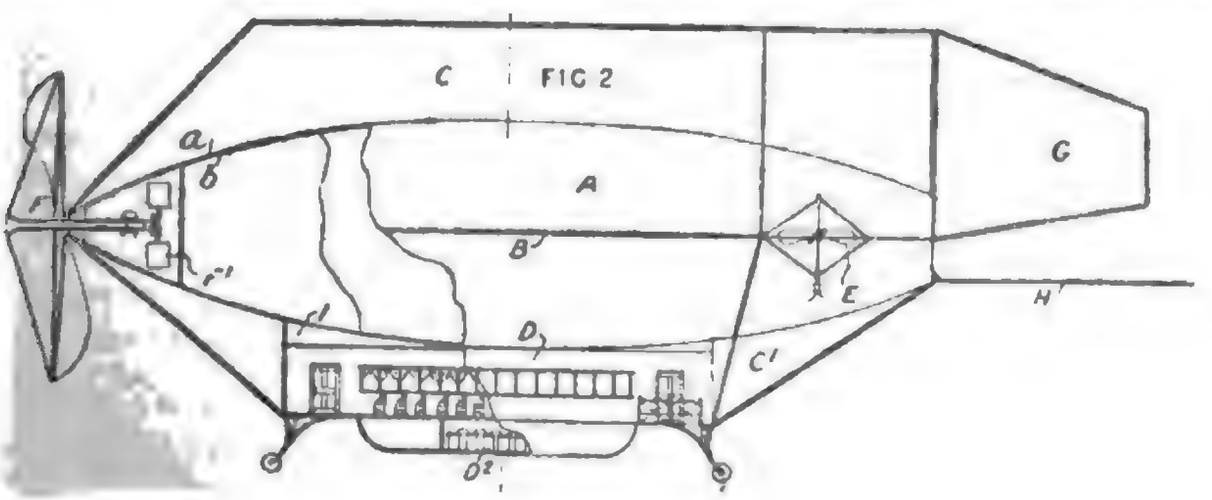
22,011. November 19, 1895. **Aerial Machines.** HOFMANN, J., 1, Lichterfelderstrasse, Berlin.

Starting.—Machines of the kind described in Specifications Nos. 7919 and 11,941, A.D. 1894, are raised from the ground at starting by mounting the machine on rods *d* from the rails *e*. When the machine is moved forward the rods move past the vertical position, and the weight of the machine is taken off the wheels and thrown on the aeroplane *a*. Or the machine may be thrown upwards by attaching the wheels *e*, Fig. 3*a*, by levers *f* to a piston in a steam cylinder *g*.



25,050. December 31, 1895. **Aerial Machine.** PENNINGTON, E. J., Racine, Wisconsin, U.S.A.

One form of the machine is shown in Fig. 2. It comprises a cigar-shaped aerostat A of aluminium, carrying at its bow a propeller F, aeroplanes B on each side, and fins C, C¹ at top and bottom. There are lifting fans E in the aeroplanes, and vertical and horizontal rudders G and H. A car D is suspended below the aerostat, with a storage chamber below that. In a modification, the car D is in the centre of the aerostat, and the



Digitized by Google

bow is made more bluff to provide more room for the engines F¹. The whole of the parts, including doors, berths, furniture, are made of aluminium, and inflated with a lighter gas than air. Cushions, footstools, &c., also contain hydrogen.

Aerostats.—The aerostat comprises shells *a*, *b* of sheet aluminium with hydrogen between them; it is stayed by hollow stays and divided by gas tight bulkheads into compartments, an axial tube is provided with manholes leading into each of the compartments. The aerostat is charged by filling it with water or by inflating a bag inside it with air and displacing the water, or causing the bag to collapse by the entrance of the hydrogen. The hollow stays may form the charging pipes.

Propelling and Steering; motors.—The main propeller F is built of sheet aluminium with hollow blades filled with hydrogen. The aluminium shaft *g* is also hollow and conveys air into the engine room. The current of air, thrown rearwards by the propeller F sweeping over the surface of the aerostat, keeps off deposits of moisture, and prevents lateral currents of wind having any effect on it. The motors F are supplied with hydrogen for fuel, which is compressed to the density of the atmosphere and stored in a number of compartments I. On the removal of the hydrogen, the compartments are filled with air of equal weight, and so maintain the balance of the vessel. The thrust of the shaft is taken against a cushion of compressed air in the bearing, kept up by an air pump, and adjusted by the axial motion of the shaft through a relief valve. Four cylinders may be arranged radially around the propeller shaft, and the charge is ignited therein by electricity from the batteries D². These batteries also supply current to electromotors for actuating the lifting ans E and the worm gearing for turning the rudders G, H. The steering is effected automatically by controlling the current by means of a compass and a barometer, the oscillation of the compass card or the barometer index finger actuating a switch which reverses the current through the motors.

1877. January 27, 1896. Aerial Machine. FRASER, T., 205, Fitzroy Street, St. Kilda, Victoria.

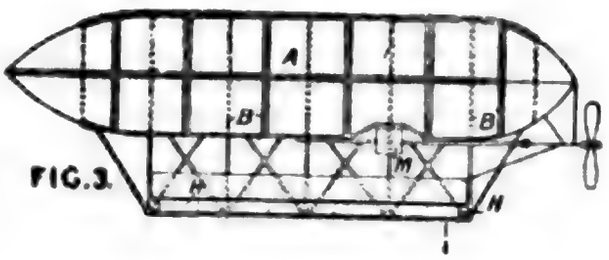


FIG. 3.

The aerostat A is cigar shaped, it is divided into compartments and filled with hydrogen. It is built of aluminium or some other thin metal and is strengthened by tubular bands B which, together with the framework for supporting the car, form the reservoirs for storing the highly compressed ammonia, carbon-dioxide, or combustible gas for use in the rotary motor M. Compressed air ballast is stored in a reservoir H, which is also divided into compartments and strengthened by tubular stays.

ERRATUM.

In the April number of the JOURNAL, for 18,148 read 18,843.

United States Patents.

(Granted April 6th to June 22nd.)

580,941. April 20. HENRY HEINTZ-ELKTON, S.D. Air-Ship.

Elongated balloon, having sufficient floating power to very nearly raise the whole weight, with posts depending from it, and a "body," or car, fastened to the lower ends of the posts, parachutes being arranged on each post. Screw propellers and rudders are attached.

582,757. May 18. LOUIS P. MOUILLARD, Cairo, Egypt. Means for Aerial Flight.

Soaring machine consisting of an aeroplane composed of two wings, each hinged upon a

vertical axis, and capable of forward and backward movement. Also a mechanical device for throwing forward the tips of the wings, with a spring normally holding the tips of the wings in advance of the axis. The wings adapted to close over one another at will.

French Patents.

260,358. SLY. Improvements Relating to Parachutes.

260,363. SCHNEIDER. New System of Dirigible Balloons.

261,716. VILLON. Flying Apparatus Moved by Human Force.

262,832. BEENEN. Flying Apparatus.

262,957. BAGGE. Method of Directing Balloons.

263,124. HÉBERT. Screw Propeller, Turbine Screw, or Parachute Screw.

263,125. HÉBERT. Flying Apparatus.

263,513. GOURJON. Dirigible Balloon.

263,646. ARSON. Gas Engine for Propelling and Steering Balloons.

German Patents.

(Class 77.)

APPLICATIONS.

ARMIN BECKMANN, Charlottenberg. Elongated Balloon.

CARL EICHLER, Wilhelmstrasse 128, Berlin. Regulating the Rise of Captive Balloons by Means of a Twofold Electric Cable.

GRANTED.

93,184. H. ISRAEL, Schönfelder Str. 15, Dresden. Flying Machine with Perpendicularly Swinging Wings. (June 11, 1896.)

93,387. J. H. HOMEISTER, Borgfelde Malzweg 18, Hamburg. Circular Captive Flying Machine. (February 20, 1896.)

CANCELLED.

70,746, 84,394, 84,567.



Revue Mensuelle

ILLUSTRÉE, DE

l'Aéronautique

Et des Sciences qui s'y rattachent.

Publiee avec **la collaboration des principaux savants francais et etrangers.**

Directeurs :

Georges BESANÇON et Wilfrid de FONVIELLE.

L'Aérophile, qui compte cinq années d'existence, a des correspondants dans le monde entier.

L'Aérophile est le plus important, le plus répandu, le mieux informé et le mieux illustré de tous les journaux similaires.

L'Aérophile s'adresse à tous les amis du progrès, même à ceux, et nous osons dire surtout à ceux, que l'étude, pourtant si attrayante, de la navigation aérienne n'a pas encore conquis.

Prix du numéro, UN franc.

ABONNEMENTS : France, un an, 10 fr. ; Union postale, un an, 12 fr.

Rédaction et Administration : — 14, Rue des Grandes-Carrières, PARIS.

Téléphone 503-24.



Etablissement Central d'Aerostation.

Ascensions et Constructions Aéronautiques.

Ballons Captifs à Vapeur.

—: Excursions Aériennes pour Amateurs. :—

Matériel Spécial pour l'Aérostation Militaire.

Lever des Plans Topographiques.

Exploration de la Haute Atmosphère :—

—: Observations Météorologiques, etc.

Georges BESANCON, Directeur,

14, RUE DES GRANDES-CARRIERES, PARIS.

Adresse Télégraphique : BESANCON, Aéronaute, Paris. Telephone No. 503.24.

L'AERONAUTE,

BULLETIN MENSUEL ILLUSTRÉ DE LA NAVIGATION AÉRIENNE.

Un numero - 75 centimes.

91, RUE d'AMSTERDAM, PARIS.

Digitized by Google

20.5
245

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF MICH.
AUG 4 1910

THE AERONAUTICAL JOURNAL



No. 4. OCTOBER, 1897. VOL. I.

Contents.

PAGE.

NOTICES OF THE AERONAUTICAL SOCIETY 1

RECENT ADVANCEMENT IN AERODYNAMICS 1

REPORTS ON EXPERIMENTS MADE BY MAJOR R. MOORE (LATE R.E.) TO ASCERTAIN THE POWER AND MEANS NECESSARY FOR FLIGHT WITH WINGS. *Illustrated* 2

ANDRÉE'S POLAR BALLOON EXPEDITION 17

NEW SUGGESTIONS FOR AERIAL EXPLORATION. CAPT. BADEN-POWELL .. 17

THE NEW GERMAN WAR BALLOON. *Illustrated* 18

NOTES: DAVIDSON'S "VOLATION" FUND — A LIFE-SAVING KITE — STEAM FLYING MODEL — THE DANGERS OF FLYING MACHINES — WARLDE'S AERIAL PROPELLER — LAMSON'S MAN-LIFTING KITE — FOREIGN AIR SHIPS — WHO FIRST SUGGESTED ARCTIC EXPLORATION BY BALLOON? — RUSSIAN AERONAUTICAL EXHIBITION 19

RECENT PUBLICATIONS 20

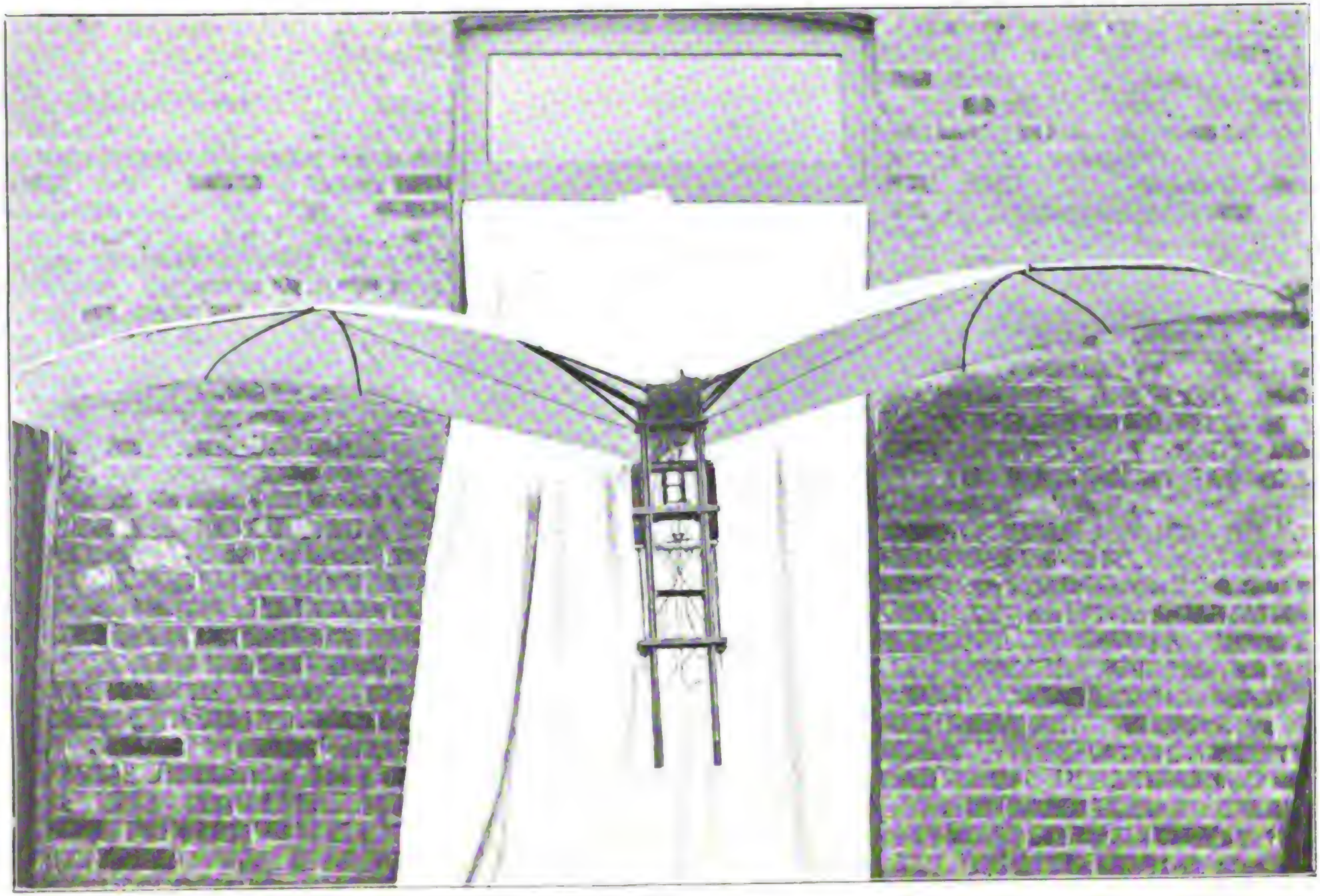
FOREIGN AERONAUTICAL PERIODICALS 21

NOTABLE ARTICLES 21

APPLICATIONS FOR PATENTS — PATENTS PUBLISHED — FOREIGN PATENTS.. 22

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.



MAJOR MOORE'S MODEL FLYING MACHINE.

Frontispiece.

Digitized by Google

THE AERONAUTICAL JOURNAL.

OCTOBER, 1897.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 8s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd.,
4, Bolt Court, 12, Gough Square,
and 4, Birchin Lane, E.C.

ADVERTISING TERMS:—10/- Per Inch, Single Column.

NOTICES
OF
The Aeronautical Society.

A General Meeting of the Society will take place in December (the exact date will be notified hereafter), when, in addition to the reading of several interesting papers, it is hoped there will be an exhibition of the Cinematograph, showing the action of flying birds, the photographs for which are now being specially procured for the Society.

Members and others are informed that the Hon. Secretary has only a few complete sets left of the Reports of the Society (1866-1893). *These are sold to the public at ONE GUINEA the set of 21 vols., or to members, at half-price* (10s. 6d).

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Recent Advancement in Aerodynamics.

Mr. Lawrence Hargrave has sent us the results of some recent experiments of his, of which we hope shortly to hear fuller details, as the subject is one of the greatest interest and importance. These experiments tend to show—

1st. That the profile of a soaring bird's wing, and pieces of metal of a somewhat similar curve, generate vortices on their concave surfaces when the chord of the curve makes a negative angle with the direction of the wind.

2nd. That all the concave surface is in contact with air moving *towards* the mean direction of the wind.

3rd. That the mean pressure on the concave surface is higher than that on the convex side.

4th. That the chord of the curved metal may make a negative angle of ten degrees with the direction of the wind, and still have a higher pressure on the concave side than on the convex.

Hence Mr. Hargrave infers:—

"That gravity can be entirely counteracted by a volume of disturbed air moving in a horizontal direction; and that flying machines of great weight can be held suspended by a horizontal wind, and rise vertically without the expenditure of any contained motor force." We would point out, however, that in order to cause this upward force to act *continuously*, either a horizontal forward thrust must be applied, or the wing be held in a fixed position, so as not to be carried back by the wind force



This subject has also been under investigation by Capt. Baden-Powell, who used an instrument consisting of an upright cylinder in the top of which is placed a fan blower to draw a current of air upwards. Smoke is introduced at the bottom so that the course of the currents may be visible. Two windows, one for admitting a strong light, the other for observation, are cut in the cylinder, and opposite the second one, inside the funnel, is a holder for carrying the model to be experimented upon, which can be fixed at any desired angle. By means of this instrument, this eddying action of the current on a concave surface is very distinctly seen, though the pressure cannot thus be determined. It will be interesting to hear with what kind of apparatus Mr. Hargrave has been experimenting.

Report on Experiments made by Major R. F. Moore (late R.E.),

To ascertain the power and means necessary for Flight with Wings.

INTRODUCTION.

The two chief methods proposed by inventors for obtaining aerial flight are by means of aeroplanes or aerocurves, driven by screw propellers, and by wings worked as in nature.

Which of these designs will practically be best it is difficult to say. It can only be by actually trying the two methods that their merits can be compared.

It may be that wings are the best, as they move a larger weight of air with less velocity than a screw propeller. The slip may on this account be less.

With a view to throw some light as to how nature solves the problem of flight with wings the following investigation has been made with a Flying Fox as a type.

The practical experiments made from the results are based on the supposition that by imitating Nature as closely as possible, both as to structure and action similar effect may be anticipated. In other words, an artificial Flying Fox should fly as well as a natural one, with an allowance made for defects in clumsiness of manufacture.

The want of a sufficiently light motor for its power has prevented these experiments being brought to a finality.

I.—INVESTIGATION OF A FLYING FOX.

In Rangoon, Calcutta, and some other parts of India flocks of Flying Foxes may be seen, towards sunset, travelling high overhead to their feeding grounds. They have a very uniform action with their wings, and their motion can be detected by the unaided eye.

The photograph (see Fig 1) is of a stuffed specimen sent to the writer from Madras.

According to Mr. M. P. Harting, as shown in the Aeronautical Society's Report for 1870, the Pteropus Edulis, as it is called, weighs over 3 lbs. avoirdupois, and measures 47¼ ins. from tip to tip of wing. The area of the wing is 126.325 sq. ins., and length 20.551 ins.

Mr. Harting says that the weight he quotes may be wrong, as it was taken from a dead specimen.

From measurements of a similar sized Flying Fox when alive it was found to be about 2 lbs. instead of 3 lbs.

This difference in weight alters the constants as given in Mr. Harting's formulæ (see page 68 to 70 of the Society's Report for 1870).



FIG. 1.—FLYING FOX (under side).

If w, a, and l represent respectively the weight in grammes, the area in square centimetres, and the length of the wing in centimetres, then we have for the Pteropus Edulis in the formulæ where

$$a=(n\sqrt[3]{w})^2$$

$$l=r\sqrt[3]{w}=m\sqrt{a}$$

$n=2{\cdot}95$ instead of $2{\cdot}55$

$r=5{\cdot}27$,, 468

$m=1{\cdot}83$ as before.

(See Appendix A.)

Digitized by Google

By Appendix B, using the corrected formulæ, we find that for a Fox weighing 200 lbs. we require wings 7¾ ft. long each, and an area of 18¼ sq. ft. each. Wings this size should therefore suit for a Bat or Fox equal in weight to a man taken at about 14 st.

It is possible to test the velocity of flight of these animals by attaching a thread to their hind claws, and noting the time in which they run out a certain length.

It has been found by this means that a Fox that makes 3 strokes per second with its wings travels 21 ft. per second, so that for each stroke up and down of its wings it travels 7 ft. This rate of progress is some 14⅓ miles per hour. This is slower than what the Fox would do if free and in full flight. The string dragging behind it probably checked its momentum.

These Foxes hang all day from the branches of high trees by their hind claws, with their heads downwards. It is only in the evening and at night they fly any distance, unless disturbed. When they want to fly they drop downwards and launch themselves off on the air.

When allowed to go free on the ground they generally make for the nearest tree or high place to climb up before flying off, though they have been known to fly from the ground direct. To do this they first distend and inflate their wings by getting air underneath, and then take off apparently with considerable extra exertion.

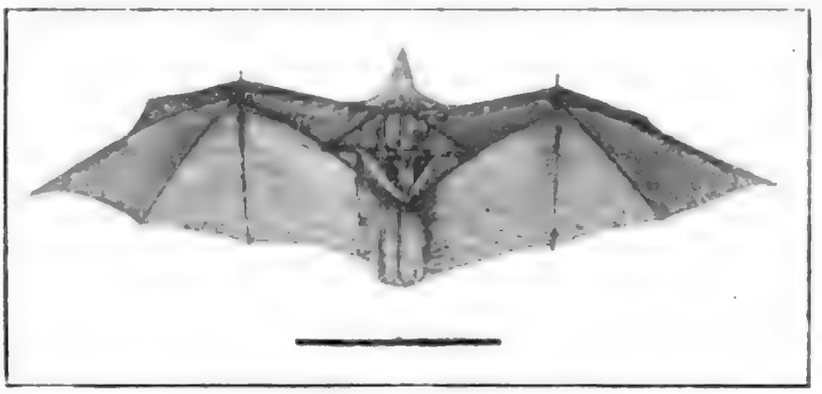
These Foxes, besides their own weight, can fly with their young clinging to them. A Fox weighing 18 ozs. carried a young Fox weighing 4 ozs., or two-ninths of its own weight. In addition it carried a string and strap weighing ¼ oz.

Their bodies are covered with hair, and they have a head like a Fox.

The wings are formed of bones, covered with a membrane. The bones resemble those of a human arm and hand, and are similarly named, viz., the main arm, or humerus, the fore-arm, or radius, and the digits, composed of 4 fingers and a thumb. (See Fig. 2.)

The wing is constructed so as to be very stiff along the front edge, and very pliant at the rear edge. There is a ball socket at the shoulder joint, but not at the elbow. This shows that the wing is rigid in itself when distended, and that the socket at the shoulder is the only hinge where movement takes place for flapping. Any alteration in the wing during flight is due to its flexibility. The joints at the elbow and wrist are called into play when the animal requires to fold its wings. This it does when it comes to rest, such as when hooking itself on to a tree.

When the wing is fully opened out the main-arm and fore-arm form an angle of 110 degs.



Model Flying Fox.

The joint at the elbow is raised above a line from the shoulder to the wrist by 1-18th of the length, so that the underside of the wing is concave.

The fourth finger is nearly parallel in plan with the centre line of the body. In line with it, extending to the front, is the thumb. This acts as a strut to a strong sinue which stretches from the shoulder to the end nearly of the first finger. This sinue forms a sharp cutting edge for the membrane which covers the wing, and it also distends the wing by its attachment to the first finger.

The second and third fingers divide the space unequally between the first and fourth fingers, and assist with them to spread the membrane of the wing.

The legs are in rear of the body. They are straightened when flying, and distend the membrane for that part to form a kind of tail.

When looking at a Fox from below, as it flies in the air, the tips of the wings cannot be seen by the naked eye. The wings take the

shape of two squares, with two triangles constructed on their outer sides, as shown in Fig. 3. This sows that the tips of the wings and posterior edges are turned up with the pressure of the air acting under the wings.

The area of one wing, as mentioned before, is 126.325 sq. ins. for a Fox weighing 2 lbs. Of this the membrane of the tip to the line of the first joints measures 26 sq. ins., or nearly one-fifth of the whole area. The membrane between the lines of the first and second joints measures 28.9 sq. ins. These two portions added together measure 54.9 sq. ins., which is approximately three-sevenths of the whole area.

Taking the weight of the Fox as 2 lbs., we find this load is flown with a spread of some 250 sq. ins. in the two wings. This is equivalent to 1.152 lbs. per sq. foot.

If the area of the body is taken into consideration in the spread, the load would be about 14 ozs. per square foot.

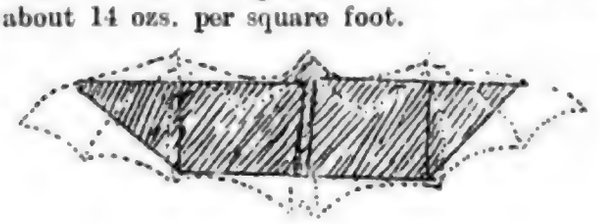


FIG. 3.

The membrane at the tail, which is distended by the legs, is apparently used for guiding and checking the motion of translation when necessary.

The aeroplane of the Fox when spread may be considered for the portions, (*a*) that act as a support on the air, (*b*) for driving, and (*c*) for guiding or checking the motion.

The Fox when flying makes 120 to 180 strokes per minute with its wings.

The amplitude, judged by the eye, does not exceed 45 degs. when in full career.

The wings are worked by the breast muscles, to which they are attached by ligaments.

The pectoral muscles is the name given to the largest pair of the breast muscles, and are the ones that pull the wings down. The body is suspended between the wings by these muscles when on the air, and by their action cause the body to oscillate in a vertical direction to reciprocate with the motion of the wings to produce flight.

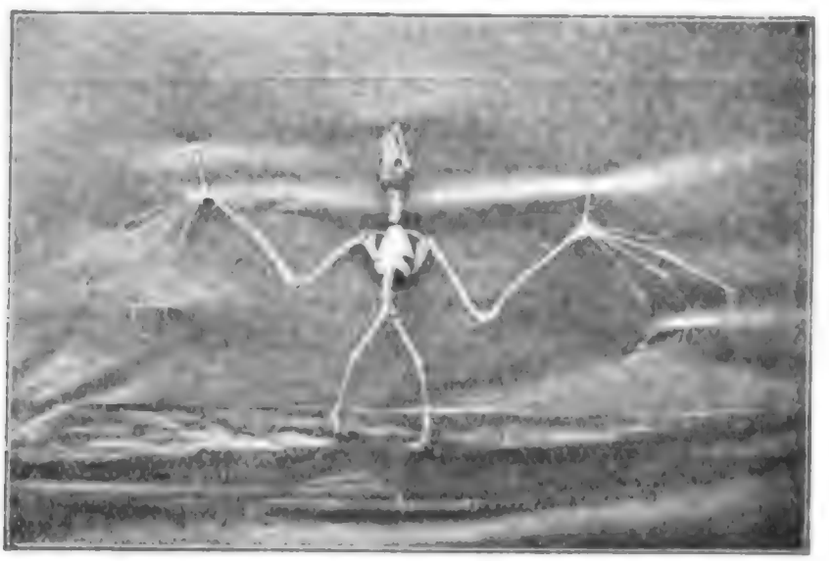


FIG 2.—SKELETON OF FLYING FOX.

The pectoral muscles take the strain of the leverage of the wings when on the air, and it is believed are actuated by nerves in connection with the brain.

The pectoral muscles are attached to the humerus at a place about one-sixth the length of the humerus out from the shoulder.

The way in which the breast muscles act in the case of birds to work the wing is very clearly described in Mr. F. W. Headley's book on "The Structure and Life of Birds."

How muscles can be made to contract by the action of an electric current, and so perform work, is described in Dr. J. Rosenthall's book on "Muscles and Nerves."

II.—ARTIFICIAL IMITATIONS OF NATURE.

Since commencing experiments, in imitation of the Flying Fox, with wings, it has been noticed that Professor Pettigrew, in his book on "Animal Locomotion," etc., page 111, says:

Digitized by Google

"In the aerial machine, as far as yet devised, there is no sympathy between the weight to be elevated and the lifting power, whilst in natural flight the wings and the weight of the flying creature act in concert and reciprocate, the wings elevating the body the one instant, the body by its fall elevating the wings the next. . . ."

This statement of Professor Pettigrew is in accordance with the idea on which the following experiments have been made. His difficulty appears to have been to apply his theory practically.

Again, Professor Pettigrew says further down in his book: "Weight, assisted by the elastic ligaments or springs which recover all wings in flexion, is to be regarded as the mechanical expedient resorted to by nature in supplementing the efforts of all flying things."

The elastic ligaments he speaks of as supplementing Nature are found by these experiments to take the whole strain of the wings, and also quicken the action of the power put into them by their resilience.

This quick action is not due to "some mysterious chemical action which is propagated more readily in the muscles of birds than in those of any other animal," as stated by Marey in his book on "Animal Mechanism," page 215. The following experiments show that it is due to the reaction of the muscles in consequence of their elasticity or resilience, as stated above. In Marey's book on "Movement," published since in 1895, he, however, at page 162-164, foot note, speaks of this rebound action.

This action of the muscles can be imitated by using springs in their place.

If we hang a weight of 20 lbs. on a spring balance the spiral spring inside (which in Salter's balance for weights up to 75 lbs. is 6 ins. long) is stretched $\frac{13}{16}$ in. If we jog it by adding an extra pressure to the load, and then quickly remove the added load, the spring with its weight will oscillate vertically some 240 times per minute. This is what happens in the case of the pectoral muscle when working, only the added load or pressure is added each stroke for continuous action.

The number of oscillations the spring will make in a given time depends on the amount of weight put on it, and the length of the spring.

If the weight put on the spring is increased

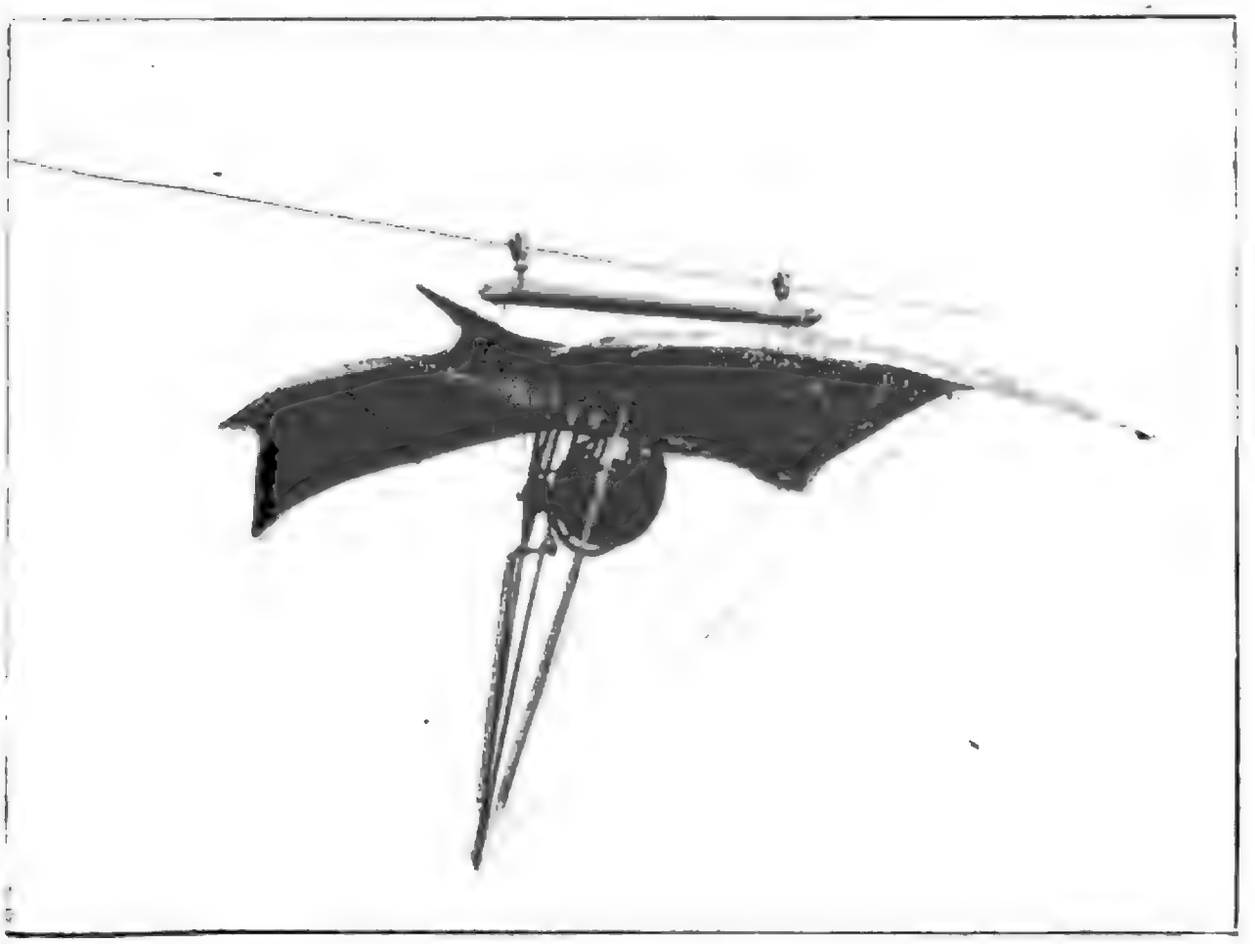


FIG. 4.—CLOCKWORK MODEL

Digitized by Google

the number of oscillations will be reduced: thus, if we double the load to 40 lbs., the oscillations become 180 per minute instead of 240, which is a reduction of some 25 per cent.

If we double the length of the spring, instead of doubling the load on it, the oscillations are 140 per minute instead of 240, which is a reduction of some 40 per cent.

It may be seen from this that springs vary in the number of natural oscillations they make when actuated in some ratio depending on the amount of load put on them, and their length.

The pectoral muscles of different species of birds vary in their thickness, weight, and length for the same reason. Mr. Hargrave shows that the pectoral muscles vary in relation to the weight of the body in bats and birds from 1 in 15.5 to 1 in 6.08. Some birds have a more rapid action than others, though their weight is much the same. Marey, at page 228 of his book, shows the number of strokes of the wing to vary from 3 to 9 per second for certain birds, as given in his list. A sparrow he shows makes as many as 13 strokes per second.

The power to be put into the springs, when strained, to actuate them is the added load for each stroke, acting through a certain space in a certain time. Its amount depends on the stiffness of the spring concerned, so that if any particular length of oscillation is required, the load added each stroke or power must be great enough to effect it.

By practically ascertaining what springs would replace the pectoral muscles in any particular flying animal, it is possible to ascertain what mechanical power is required to work its wings with the number of strokes and amplitude as in nature.

To investigate this models have been made in imitation of the Flying Fox, with artificial wings. Natural wings are difficult to fix. (See Frontispiece and Fig. 4.) The way artificial wings and machines are constructed is described in my patent specification, No. 6, 1895.

III.—STRAINS AND STRESSES.

The wing is a lever of the third order, where the power comes between the fulcrum and the load. The only difference is that in the case of the wing, the lever is turned over so that the strains are reversed (see Figs. 5 & 6. "A" is the Fulcrum, $\frac{S}{2}$ the strain keeping the wing down, $\frac{p}{2}$ the pressure of air under the wing acting upwards at the centre of pressure.



FIG. 5.



FIG 6.

The strain on the springs is that due to the leverage of the wings as when resting on the air. Thus, if $\frac{p}{2}$, $\frac{p'}{2}$ represent the pressures of the air at the centres of pressure of the wings at say distance "y" from the shoulder joints, and $\frac{S}{2}$, $\frac{S'}{2}$ are the strains on the springs at distance "x" out, then taking moments (see Fig. 6), we have

$$\frac{S}{2}x = \frac{p}{2}y,$$

$$\therefore S = p\frac{y}{x} \quad \ldots\ldots \text{(i.)}$$

Now $p = w$, the total weight of the machine,

$$\therefore S = \frac{y}{x}w \quad \ldots\ldots \text{(ii.)}$$

This is approximately the strain the springs have to sustain when the body and wings are resting on the air in flight.

Strong enough springs must be selected for any particular machine that are capable of taking this strain without injury to the elasticity.

They must at the same time, as said before, be capable of giving the right number of oscillations per minute when actuated under this strain and the right amplitude.

In the case of the Flying Fox, 120 to 180 strokes per minute for the wings have been counted. The number made by different species of flying animals varies considerably as already stated.

It is difficult to say what the amplitude of the wing should be; this also varies considerably, even in the same flight. It is taken that it should not be less than 30 degs.

With regard to the size of the wings: the smaller, or rather shorter, they can be made for any particular load the better, as this reduces the leverage; on the other hand the smaller they are, the greater must be the horizontal driving power to obtain the increased sustaining pressure per square foot of area of wing.

An ordinary Flying Fox does not fly much more than 1 lb. per square foot of wing area. From the table given in Mr. Chanute's book (pages 46, 47), it may be seen that for different species of flying animals, the amount varies from $\frac{1}{2}$ lb. to $2\frac{1}{2}$ lbs. per square foot.

For the greater weight supported, the wings are narrow and long instead of short and stumpy as in the case of the Flying Fox, though the area of the spread may be the same. The greater length of wing for the same number of flaps causes the tip to travel through a longer space in the same time. The tip of a wing twice as long as another would have twice the velocity. Again the pressure on the air caused by the fanning of the tip varies with the square of the velocity, so that in the case above, if one wing is, say, 2 ft. long and the other is 4ft. the velocities are as 2 to 4, and the pressures on the air are as 4 to 16.

The longer wing therefore might be expected to fly four times the load per square foot of its spread than the shorter one, if no account is taken to the extra resistance of the air.

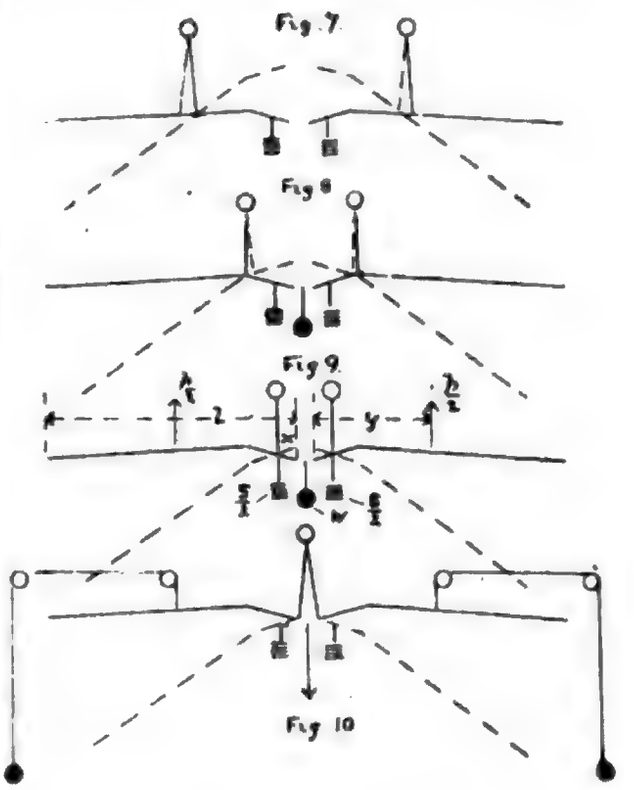
Mr. Maxim has flown in his machine with a load of 2 lbs. per square foot. Mr. Phillips' machine rose with $2\frac{1}{2}$ lbs. per square foot. Lilienthal soared with 1.45 lbs. per square foot. From this it is evident that it is possible to arrange some mechanical means that will fly with a load which is up to that flown in nature, namely, $2\frac{1}{2}$ lbs. It is chiefly a question of obtaining the best driving power for the weight.

IV.—PRACTICAL METHODS FOR TESTING THE STRAINS AND STRESSES.

To test the strains and stresses under which the wings of the machine work as described in the patent specification, it is suspended in different ways, preparatory for free flight.

1. At the centres of pressure of the wings, when the body rises and falls each stroke (see Fig. 7).

2. At the apexes of the wings, with added weights (see Fig. 8). The added weights are the equivalent for the leverage on the air, and cause the correct strain to the springs.



3. At the point of attachment of the springs with added weights (see Fig 9).

4. At the body with balanced weights for the pressure of the air at the centres of pressure (see Fig. 10).

5. At intermediate places between the hinge and apexes of the wings with calculated added weights.

6. With the position of the attachment of the springs to the main arm also varied.

In cases ii., iii., and v., weights have to be added to that of the body to strain the springs and compensate for the effect of the

Digitized by Google

pressure of the air under the wings as when flying.

The machine being suspended, cannot get its horizontal momentum to create the supporting pressure as in flight, so calculated weights are added to make up for this.

To find the weight to be added to strain the springs correctly, we know that the sustaining pressure at the centres of pressure of the wings must be equal to the whole weight of the machine, so that if $\frac{p}{2}$, $\frac{p'}{2}$ each equal these pressures, if w equals the weight of the machine, and if w_1 is the weight to be added as the equivalent for the pressure of the air, we can find the amount by taking moments about the point of support when (Fig. 9),

$$w_1 x = 2\frac{p}{2}(y-x),$$

$$\therefore w_1 = \frac{y-x}{x} p \quad \ldots\ldots \text{(iii.)}$$

$$= \frac{y-x}{x} w.$$

From this equation it may be seen that the smaller x is, the larger is the weight to be added. In other words, the nearer the point of suspension is to the hinge, the greater must be the weight to be added.

If the point of suspension is at the hinge itself, as shown in Fig. 10, the weight to be added must be infinite; the body would then be fixed, and all the motion would be in the wings. Balanced weights have to be used in this latter case as the equivalent to the pressure of the air at the centres of pressure (see Fig. 10).

If x equalled y, then the point of suspension would be at the centre of pressure as shown (Fig. 7), and the maximum motion would be in the body. In this case no extra weight for strain would have to be added.

When making experiments with springs fixed at different distances out, the best result was obtained for wings 2 ft. long when the springs were fixed in the same position as the pectoral muscles in nature. This is about 1-6th the length of the humerus out, or 1-36th the length of the wing from the shoulder joint in the case of the Flying Fox.

This point where the pectoral muscle is attached is also the best point for suspension, and is assumed to be the point of non-oscillation in the wing in flight for wings up to 2 ft.

As the wings increase in length the springs must be brought closer to the shoulder joint than 1-36th the length of the wing, or the lift each stroke would become too great to admit of sufficient amplitude and to give the right number of strokes in the time.

The springs, with their load, act under the influence of gravity, so that the height of the lift must be regulated for the quickness of action required. Thus by the formula in Dynamics we have

$$h = \frac{1}{2} g t^2,$$

where in this case $t = \frac{1}{2} \times \frac{60}{144}$ seconds

$= \cdot 2$ of a second.

Marey, in his book (page 223), shows that the time of descent of the wing is greater than the time of ascent as 5 is to 3, approximately, so that the time of descent in this case is taken at ·3 of a second instead of ·2,

therefore $h = \frac{1}{2} \times 32 \cdot 2 \times \cdot 3^2$

$= 16 \cdot 1 \times \cdot 09 = 1 \cdot 45$ inches.

This would be the rise of the body each stroke if it were not for friction and the resistance of the air.

For an amplitude of 30 degs. the angle of rise is about 1 to 2, so the springs which are attached at the point of non-oscillation must not be fixed out on the humerus at a distance exceeding twice the rise, or in this case twice 1.45 ins. from the shoulder joint for a rate of 144 strokes per minute. (See Fig. 9.)

On the other hand the springs must be fixed as far out as admissible for the number of strokes required as friction is increased due to the extra stresses from the leverage of the wing.

Knowing approximately the position for fixing the springs for any particular machine, we must now select those that will stand the strain, and at the same time give the right amplitude when actuated, and the right number of oscillations.

The work expended for flight is the amount necessary to actuate the springs, and so cause the body with its added weight for strain to oscillate up and down in a vertical direction, and so give the necessary amount of amplitude to the wings, and the necessary number of strokes per minute.

For an amplitude of 30 degs. the amount the body has to be lifted equals $\frac{x}{2}$ each stroke, or $\frac{l}{35}$, where "x" as before equals the distance out of the point of non-oscillation from the shoulder joint of the wing, and "l" equals the length of the wing.

The number of strokes is taken at 144 per

minute, being the approximate average number for a Flying Fox.

The centre of pressure of the air under the wing is taken as acting at $\frac{4}{9}\,l$, the length of the wing from the shoulder joint, as shown in Mr. Chanute's book, page 41.

If w_1 is the added weight for strain as shown in equation iii., page 28, then

$$w_1=\frac{y-x}{x}\,p$$

where $y=\frac{4}{9}\,l$; $x=\frac{l}{36}$, $p=w$,

therefore $w_1=\frac{\frac{4}{9}\,l-\frac{1}{36}\,l}{\frac{1}{36}\,l}\times w=15\,w\,l$ (iv.)

As the weight of the body has also to be lifted, the total weight to be raised each stroke

$$=15\,wl+w$$
$$=(15\,l+1)\,w \quad \ldots\ldots\ldots \text{(v.)}$$

The work to be done per minute

$$=(15\,l+1)\,w\left(\tfrac{1}{2}\times\frac{l}{36}\right)144$$
$$=(15\,l+1)\,2\,wl \quad \ldots\ldots\ldots \text{(vi.)}$$

For a Flying Fox with 2′ wings, and weighing 2 lbs., we have for flight

$$\text{work}=2\times2\times2\,(15\times2+1)$$
$$=8\times32=248 \text{ ft. lbs.}$$

This is at the rate of 1 H.P. for 264 lbs.

Again, if we take the size of a Fox as calculated in Appendix B, we have

$$w=200 \text{ lbs.}, \quad l=7{\cdot}75',$$

then by equation vi. we have for flight

$$\text{work}=(15\times7{\cdot}75+1)\,2\times200\times7{\cdot}75$$
$$=363470 \text{ ft. lbs.}$$

This is at the rate of 1 H.P. for 18 lbs.

This difference of rate of load per horse power between a Flying Fox weighing 2 lbs.

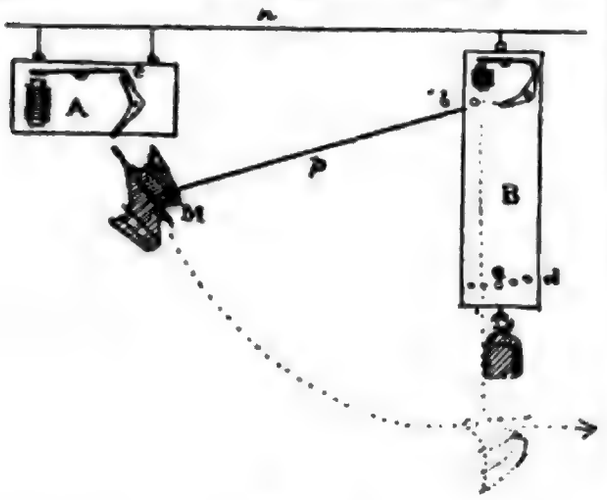


FIG 11.

and one weighing 200 lbs. may be accepted as due to the extra velocity of translation necessary for the latter to obtain a greater supporting pressure on the air. In the former case the pressure is under 1 lb. per square foot and in the latter is 5½ lbs., which is an extreme case.

Again it may be seen by a special calculation, (Appendix G), that for a load of 125 lbs. with a pressure of 2½ lbs. per square foot on the wing area, 1 horse power would fly over 100 lbs.

The power necessary for flight for heavier loads per square foot of wing area increases on a sliding scale. It is well to keep the total load down for any one machine as much as possible. Each man should have his own machine for this reason.

After having adjusted a machine for the correct strain on the springs as shown above it can be launched on the air in free flight.

For this slip catches have been used, worked with electric currents (see Fig 11).

These slip catches are hung from an overhead wire, and are arranged to throw off the machine at different angles of inclination to the ground as required for experiment, and with different amounts of momentum by altering the drop.

It is found that the machines go off best on the air when the inclination of the body is ⅛ to the horizon.

V.—EXPERIMENTS WITH MODELS TO ASCERTAIN THE POWER REQUIRED FOR FLIGHT.

The first model has wings driven by a clock spring. When the spring is released the model runs along the wire from which it is suspended. This experiment shows that the wings, when flapped, give a horizontal driving force. The best effect is found to be when the body is inclined upwards ⅛ to the horizon (see Fig. 4).

From calculations for this model the power necessary for flight is at the rate of 1 h.p. for 162 lbs. (See Appendix C.)

With a clock spring, as used in the first model, the power could not be varied conveniently nor could it be made to work continuously. Experiments have been made since with models fitted with electro motors to work the wings. (See Fig 12.)

Electro motors are convenient in many ways for experimental purposes.

(*a*) The motor alone may be fixed in the machine, the electric current being conveyed to it by wires. This dispenses with the weight of the dynamo or electric battery for supplying the current.

(*b*) Electro motors are simple in their construction, compared with steam engines or gas engines, and can be easily interchanged.

(*c*) They are simple to put in motion or stop,

as it is only necessary to connect or disconnect the current.

It is found that a direct acting motor as fitted in the models (see Frontispiece), gives out better work efficiency than a rotatory one, as there is less friction with it. A description of it, and how it works is given in the specification patent, No. 6, of 1895.

A model, fitted with one of these motors, when fully loaded, including the storage battery weighs 3 lbs. 6 ozs. The added load for the strain on the springs is 50 lbs. The springs are fixed at ⅛ in. out from the shoulder. The best results gave 144 strokes per minute with an amplitude of 17 degs. A much stronger motor is necessary for this model, as the amplitude should be at least doubled to be sufficient for free flight.

For calculation of the work required, see Appendix E, where it is shown that it would amount to 500 ft.-lbs. to fly the model. The rate of load per horse power is 226.4 lbs.

With another larger direct acting motor fitted on arms working on ball bearings, 144 strokes per minute were obtained with an amplitude of 26 degs. (see Fig. 13). The springs in this case were fixed 11-16th in. out, and strained with a dead load of 220 lbs.

From the calculations (Appendix F), it may be seen that the work done equalled 907.5 ft.-lbs. The load this would fly at 226.4 lbs. per horse power as shown above would be 6.2 lbs. The length of the wing should be 30 ins. The pressure to be maintained per square foot of area of wing = 625 lbs.

These experiments with direct acting electro motors, show that though the action may be right for flight, a lighter and more powerful kind is necessary.

It is believed that some of the gas engines as lately developed for motor cars would give the action as required within the limits of weight.

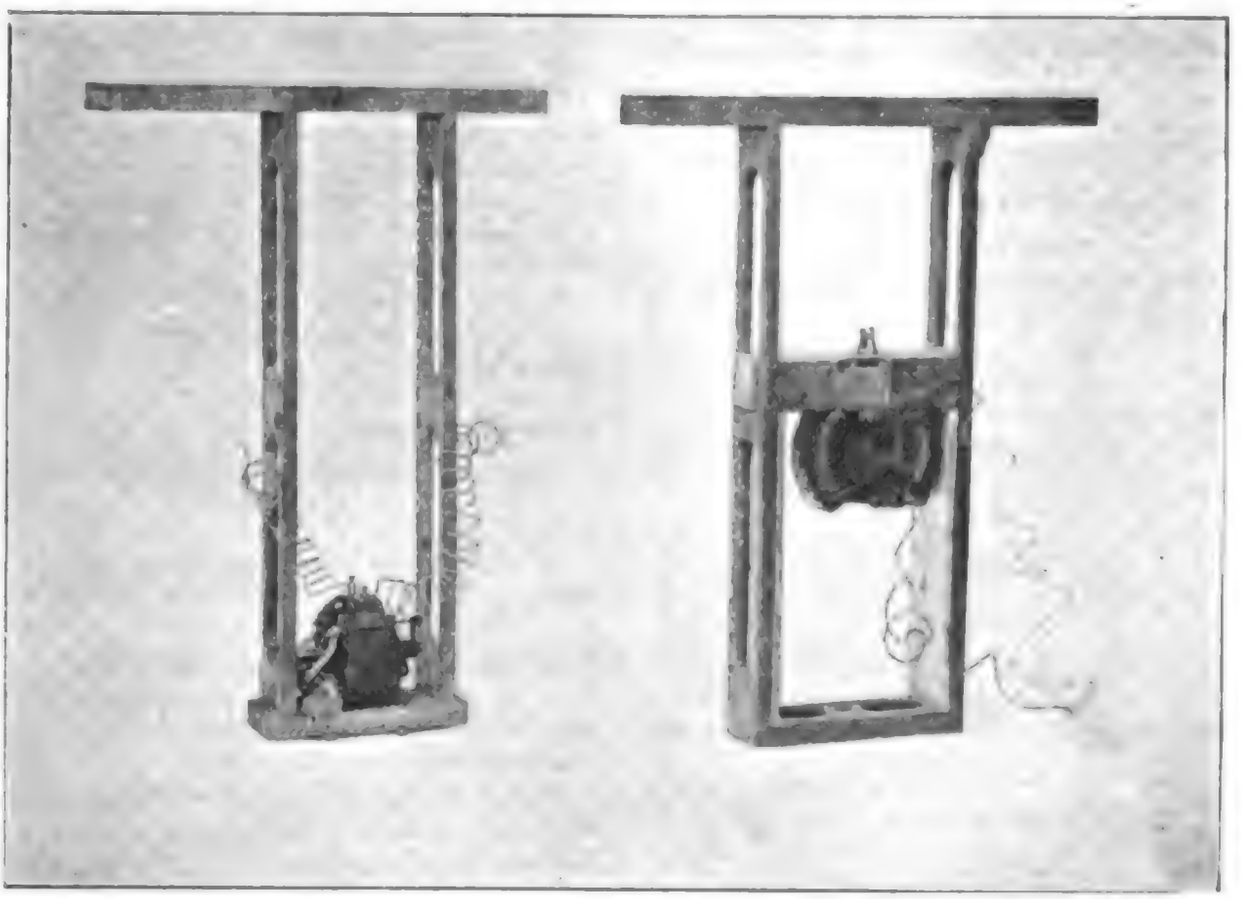


FIG. 12.—ELECTRO MOTORS MOUNTED ON FRAMING TO TAKE WINGS.

For wings fitted with a rotatory electro motor, as shown in Fig. 12, we have

weight = 10·4 lbs.,

length of wing = 4¼ feet (each),

distance out of point of attachment of crank rod = 2·875″

do., of spring = ·75,

do., of point of non-oscillation or point of suspension = 2·875, or the same as that of the crank rod.

Digitized by Google

Calculations for the following are given in Appendix D.

1. Added weight to cause strain.
2. Strain on springs.
3. Work exerted to produce 96 strokes per minute of 30 degs. amplitude.
4. Work necessary for flight.
5. Rate of load per horse power.

It may be seen from the last calculation that it requires, judging from this model, 1 horse power to fly 196.68 lbs.

A more favourable result might be expected if all the working parts were fitted with ball bearings in this model to reduce friction, also if account was taken of the work expended in fanning the air. This must be considerable, as the wings even at 96 strokes per minute drive the model forward forcibly by the breeze created.

The motor used in this model is one of Cultriss' weighing 4½ lbs. and capable of developing 1500 ft.-lbs. when running at 200 revolutions per minute. In the experiments it was running at 1900 revolutions, and gave out 720 ft.-lbs. of useful work. Nearly half its power was lost in friction.

The following is a summary of the results obtained from these experiments of the rates of load that can be flown per H.P.:

(*a*) Spring model 162 lbs. per H.P.

(*b*) 2′ wings, direct motor 226 lbs. per H.P.

(*c*) 4¼′ wings, rotatory motor 196 lbs. per H.P.

(*a*) is estimated from the strength of the driving spring (see Appendix C.).

(*b*) from the strength of the springs acting for the pectoral muscles (see Appendix E.).

(*c*) from the direct lift of the body, with the calculated strain on the side springs (see Appendix D).

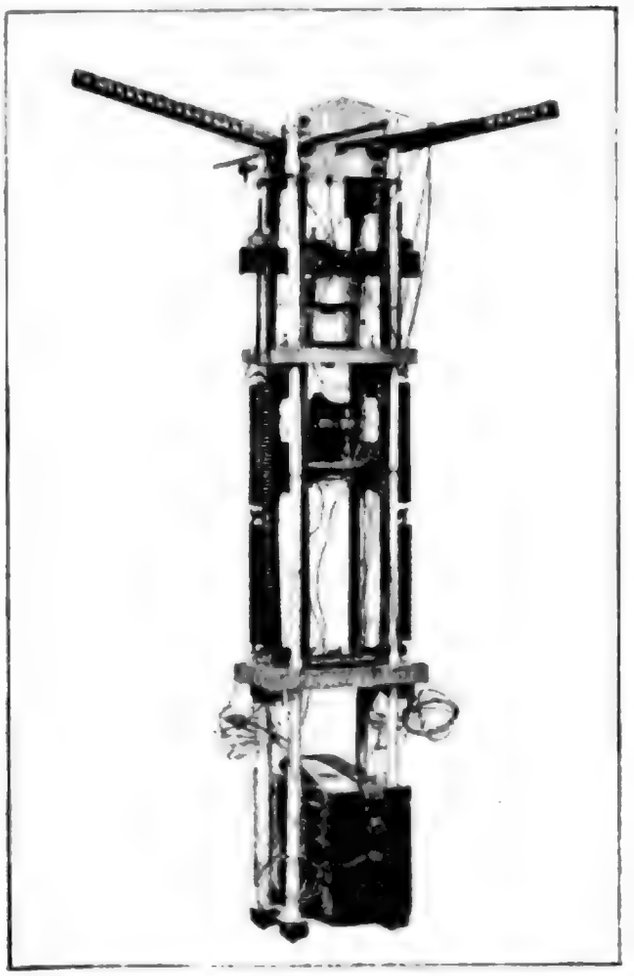


FIG 13.—ELECTRO MOTOR WITH FRAMING TO TAKE WINGS.

VI.—CONCLUSIONS.

For a big machine capable of flying a man, it would be best to have four wings, two on each side (see Fig. 14). This would be two machines as already described joined together like in tandem. This arrangement would steady the machine in the direction of its motion. A vertical and horizontal rudder can be added if found advantageous. An inclination of about $\frac{1}{8}$ appears to be the best for the body when in the air as far as these experiments show.

Another advantage in having four wings, or even more, instead of two, is that the leverage to the centres of pressures is reduced for the same spread, so that the strain on the wings is less, and they can be more lightly constructed. They also would not be so unwieldy.

The better horizontal stability ensured enables the centre of gravity to be raised higher in the machine as there is less tendency to dip and rock.

If the total load is taken as 250 lbs., which is 125 lbs. for the aviator, 100 for the framing and springs, 25 lbs. for the motor and fuel, we can see by Appendix F that there should be four wings, each 9 ft. 2 ins. long (see Fig. 14).

This calculated speed would be modified by the resistance of the air which increases with the square of the velocity of translation.

Chanute shows in his table of supporting areas of birds (page 47), that a speed of 66.2 miles per hour is sufficient for 2.28 lbs. per square foot, so it may be taken that a speed of some 70 miles per hour would be enough for 2½ lbs.

In Appendix G are given calculations for the following:

(*a*) Strain on the springs.

(*b*) Equivalent weight to give strain.

(*c*) Horse power necessary for flight.

It may be seen that it will require a little over 2 horse power to fly the 250 lbs.

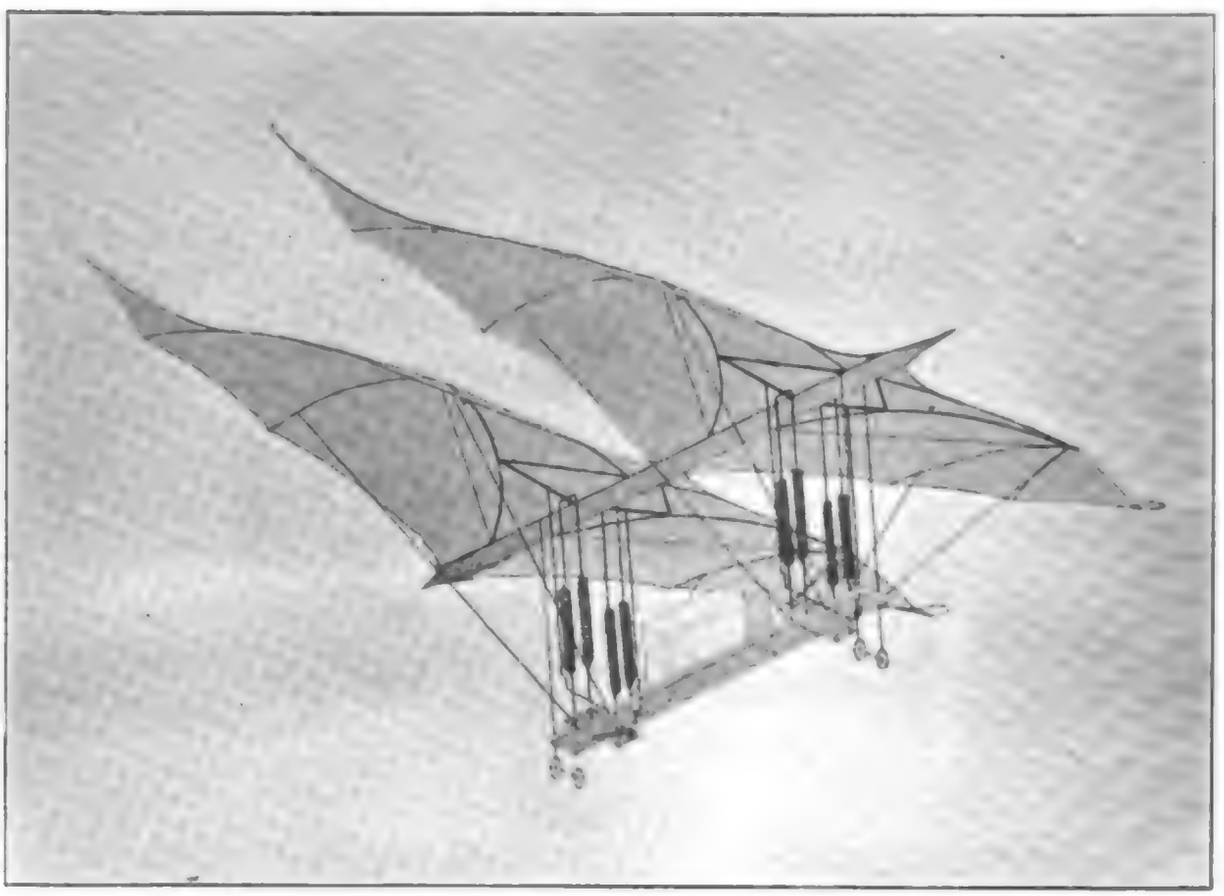


FIG. 14.—DESIGN FOR LARGE FLYING MACHINE.

The machine could be fitted with one motor to work the two pairs of wings in preference to two separate motors for each pair.

The total area of the 4 wings=100 sq. ft.
The load per square foot =2½ lbs.

The velocity of the tips of the wings vertically would be more than 30 times greater than for a Flying Fox which travels at over 14½ miles per hour. It is calculated from this that the tandem machine with the 9 1-6th ft. wings should travel at 118 miles per hour.

For starting the one man machine it will be necessary to assist the wings by letting the machine run down an incline or to shoot it off with some extraneous power as a rocket or spring. If it could be placed on top of a railway carriage, it could be shot off from it when the momentum was found sufficient.

The preliminary experiments should be made without a man in the machine, when a weight might be added in his place.

In Appendix H is given a calculation for larger wings than the 9 1-6th ft. ones proposed,

Digitized by Google

so as to reduce the load per square foot of area. It may be seen that if the area was doubled so as to reduce the pressure to 1¼ lbs. per square foot the wings would have to be 12 ft. 11¼ ins. long each, which would be more unwieldy than the shorter ones, so nothing would be gained.

To summarise:

(*a*) The wings of a Flying Fox can be imitated artificially, and to an enlarged size.

(*b*) Artificial wings can be balanced with springs against the weight of the body when on the air in imitation of the pectoral muscles.

(*c*) Artificial wings, when properly constructed, generate a propulsive force when flapped.

(*d*) The pectoral muscles can be imitated by spiral springs if specially selected for the strain so as to impart the right number of strokes per minute, and amplitude when actuated with suitable power.

(*e*) Two or more pairs of wings are better than a single pair for a flying machine.

1. To give better equilibrium.
2. To economise leverage.

(*f*) Motors are being made lighter and more efficient for their weight every day so that there is every hope of a convenient and suitable one being available.

There is therefore nothing to prevent a practical flying machine being made with wings in imitation of those of a Flying Fox.

R. F. MOORE.

APPENDIX A.

To find the values of n, r, and m, as given in Mr. Harting's formulæ, page 68 of the Aeronautical Society's Report for 1870, when weight is taken at 2 lbs. instead of 3·042 lbs. for the Pteropus Edulis.

We have in French dimensions

weight $= w = 2$ lbs. $= 2 \times 453{\cdot}6$ grammes $= 907{\cdot}2$,

length of wing $= l = 20{\cdot}551'' = 20{\cdot}551 \times 2{\cdot}54$ centimetres $= 52{\cdot}197$,

area of wing $= a = 126{\cdot}325$ sq. in. $= 126{\cdot}325 \times 2{\cdot}54^2$ square centimetres. $= 814{\cdot}96$ square centimetres.

(i.) $$n = \frac{\sqrt{a}}{\sqrt[3]{a}} = \frac{\sqrt{814{\cdot}96}}{\sqrt[3]{907{\cdot}2}} = 2{\cdot}948 = \underline{2{\cdot}95}$$ say instead of 2·55.

(ii.) $$r = \frac{l}{\sqrt[3]{w}} = \frac{20{\cdot}551 \times 2{\cdot}54}{\sqrt[3]{907{\cdot}2}} = 5{\cdot}269 = \underline{5{\cdot}27}$$ say instead of 4·68

(iii.) $$m = \frac{l}{\sqrt{a}} = \frac{52{\cdot}197}{\sqrt{814{\cdot}96}} = \underline{1{\cdot}83}$$ before.

N.B.—These new values are necessary, as Mr. Hargrave takes the weight for the Pteropus Edulis, with wings 20·551″ long, too much, where

$$a = (n\sqrt[3]{w})^2 \times l = r\sqrt[3]{w}.$$

APPENDIX B.

Calculation for a Flying Fox, as to size if it weighed 200 lbs., taking the corrected values of n, r, and m as given in Appendix A

We have

$$l = r\sqrt[3]{w}$$
$$= 5{\cdot}27\sqrt[3]{200 \times 453{\cdot}6} \text{ grammes}$$
$$= 5{\cdot}27\sqrt[3]{90720}$$
$$= 5{\cdot}27 \times 14{\cdot}63 \text{ centimetres}$$
$$= \frac{5{\cdot}27 \times 14{\cdot}63}{2{\cdot}54} \text{ inches}$$
$$= 93{\cdot}22 \text{ inches}$$
$$= 7\tfrac{3}{4} \text{ feet.}$$

To find a (the area) we have

$$a = \frac{l^2}{m^2} = \frac{14{\cdot}63 \times 5{\cdot}27^2}{1{\cdot}83} \text{ sq. centimetres.}$$
$$= \underline{18{\cdot}22} \text{ square feet.}$$

As each wing has to fly 100 lbs., there must be a supporting pressure of $\frac{100}{18{\cdot}22}$ lbs. per square foot of area $= 5{\cdot}49$ lbs., say $5\tfrac{1}{2}$ lbs.

APPENDIX C.

Clock spring model (See Fig. 4.)

The spring raised 1 lb. thro. 4½′ in 3″,
therefore spring „ „ 90′ in 1′,
work = 90 ft. lbs. = ·002727 H.P.,
weight of spring = 6¾ oz.

Experiment—

Model weighing 1 lb.
Strokes, 2 per minute.

Result, model raised itself and travelled along a wire.

If the spring was stronger to give 3 strokes per second, it would give the same number as in nature.

To ascertain the strength for this,

$$\frac{v'}{v} = \frac{3}{2} \quad \frac{R}{R'} = \frac{v^2}{v'^2}$$
$$R' = \frac{9}{4} R,$$

therefore H.P. required $= \frac{9}{4} \times {\cdot}002727$
$= {\cdot}006136.$

From above, if ·006136 H.P. is enough to fly 1 lb., then 1 H.P. is sufficient to fly 162 lbs.

Digitized by Google

APPENDIX D.

Cultriss' motor for 4½' wings.

(i.) *To find the equivalent weight* for strain to be added to body of model when suspended at points of attachment of crank rods. (See Fig. 15.)

In this case

$$w = 10{\cdot}4 = P$$
$$w_3 = 2{\cdot}8$$
$$w_4 = 4{\cdot}8$$
$$\frac{P'}{2}+\frac{P'}{2} = P' = P - \frac{18}{22}\times 2{\cdot}8 - \frac{2{\cdot}875}{22}\times 4{\cdot}8$$
$$= 10{\cdot}4 - 2{\cdot}3 - {\cdot}63 = 7{\cdot}4 \text{ lbs. say.}$$

If w_4=the weight for strain to be added, then

$$w_4 \times 2{\cdot}875 = P\,(22 - 2{\cdot}875),$$
$$w_4 = 7{\cdot}4 \times \frac{19{\cdot}125}{2{\cdot}875} = 48{\cdot}8 \text{ lbs.}$$

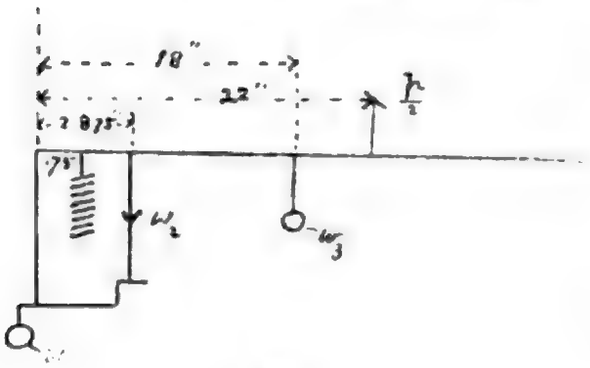


FIG. 15.

(ii.) *To find the amount of strain* on the springs. Let S=the total strain,

then $S \times {\cdot}75 = P' \times 22$

$$S = \frac{7{\cdot}4 \times 22}{{\cdot}75} = 217 \text{ lbs.},$$

therefore the strain on each side $= \frac{217}{2}$

$= 108{\cdot}5$ lbs.

(iii.) *To find the work* exerted to produce 96 strokes per minute of 30°.

The work is that required to raise (w_1+w_4) through a height of 1½" at 96 times per minute.

$$\text{work} = (7{\cdot}4 + 48{\cdot}8)\frac{1{\cdot}5}{12}\times 96$$
$$= 56{\cdot}2 \times 12 = 674{\cdot}4 \text{ ft. lbs.}$$

therefore 674·4 ft. lbs. are required to work a model weighing 10·4-lbs. at 96 strokes per minute in imitation of nature.

(iv.) *Calculation for the extra work* necessary for flight.

The number of strokes to produce this is taken at 144 per minute.

The work increases with the resistance: this is with the square of the velocity,

therefore if w'=work required,

$$w : w' = 96^2 : 144^2,$$

but $w = 674{\cdot}4$ ft. lbs.

$$\therefore\ w' = 674{\cdot}4 \times \frac{144^2}{96^2}$$
$$= 1742{\cdot}4 \text{ ft. lbs.},$$

therefore 1742·4 ft. lbs are required to fly 10·4 lbs.

(v.) *To find the rate of load per Horse Power.*

As 1742·4 ft. lbs. will fly 10·4 lbs,

1 ft. lbs „ ·00596 lbs,

therefore 1 H.P. = 33,000 ft. lbs. will fly 196·68 lbs.

APPENDIX E.

To calculate the power required for flight from experiments with a model weighing 3·4 lbs., having 2' wings.

We find by experiment that when the model is weighted with 48 lbs. added to the body, the springs at ⅝" out are stretched ·18" for each stroke of the wings at 144 strokes per minute.

The springs used on each side of the body stretch ⅛" respectively, with a load of 10 lbs,

therefore each stretches 1" with 80 lbs.

„ „ ·18" „ 14·4 lbs.

therefore the pair of springs stretch ·18" with 2×14·4 lbs. equal to 28·8 lbs.

The work done each stroke is to raise 28·8 lbs. a height of ·18" 144 times per minute

$$= 28{\cdot}8 \times \frac{{\cdot}18}{12}\times 144 = 62{\cdot}2 \text{ ft. lbs.}$$

As the amplitude should be 30° or more, instead of 17°, the work must be increased to suit for the extra resistance and rise required.

The resistance of the air to the stroke of the wing increases with the square of the velocity, so that if

R = the resistance of the air at velocity v,

R' = the resistance of the air at velocity v',

then $R : R' = v^2 : v'^2$.

As the amplitude is nearly doubled,

$$v' = 2v \text{ say},$$
$$\text{or } v : v' = 1 : 2,$$
$$\text{therefore } v^2 : v'^2 = 1 : 4$$
$$\text{„ } R : R' = 1 : 4$$
$$R' = 4R.$$

Again, to compare the work if

w = the work for amplitude 17°

and w' = „ „ 34°,

then $w : w'$ as $1 \times R : 2R'$

as $1 \times 1 : 2 \times 4$,

Digitized by Google

therefore $w' = 8\ w = 8 \times 62\ 2$ ft. lbs.
$= 497{\cdot}6$ ft. lbs.
$= 500$ ft. lbs. say.

To calculate the rate of load per Horse Power, we have

500 ft. lbs. for 3·4 lbs,
therefore 1 ft. lb. for ·0068 lbs.
,, 33000 for 226·4 lbs.

NOTE.—The writer is indebted to Mr. O. Chanute, C.E., for checking and correcting the above calculation.

APPENDIX F.

Calculation for a direct acting electro-motor on arms fitted with ball bearings, with springs at $1\frac{1}{8}$" out, and strained with a dead load of 220 lbs. (See Fig. 13.)

The arms make 144 strokes per minute, with an amplitude of 26°.

(i.) $Work = 220 \times \frac{11}{16} \times \frac{1}{2} \times \frac{1}{12} \times 144 = 907{\cdot}5$ ft. lbs.

(ii.) *To ascertain the weight* which this will fly, we have by the 2' winged model that 1 H.P. will fly 226·4 lbs. (See Appendix E.)

Therefore if w = the weight required, we have by comparison

$$226{\cdot}4 : w = 33000 : 907{\cdot}5$$
$$w = 6{\cdot}2 \text{ lbs.},$$

therefore the 907 5 ft. lbs. will fly 6 lbs., say.

(iii.) *To find the length of wing*, we have by Mr. Hargrave's formula, as corrected (see Appendix A)—

$l = r \sqrt[3]{w}$ where $w = 6 \times 453{\cdot}6$ grs.
$r = 5{\cdot}27$

$$= \frac{5{\cdot}27}{2{\cdot}54} \sqrt[3]{6 \times 453{\cdot}6} = \frac{5{\cdot}27}{2{\cdot}54} \sqrt[3]{2721{\cdot}6}$$
$= 29$ inches.

The centre of pressure is $\frac{4}{9}\ l$ out, and is therefore at $\frac{4}{9}$ of 29" out = 13" out, say.

(iv.) *To find the load to be added* for strain we have

$$w_4 \times \frac{11}{16} = P' \times 13,$$

where $P' = \frac{4}{5} \times 13{\cdot}5 = 10{\cdot}8$,

$$\text{therefore } w_4 = \frac{10{\cdot}8 \times 13 \times 16}{11} = 204 \text{ lbs.}$$

(v.) *To find the area of the wings.*

As the wings are 29" long, we can find the area by the formula (see Appendix A)—

$$a = \frac{l^2}{m} \text{ where } m = 1{\cdot}83$$
$$= \left(\frac{2{\cdot}5}{1{\cdot}83}\right)^2 = 1{\cdot}866,$$

therefore for the two wings, total area $= 3\frac{3}{4}$ sq. ft.

(vi) *To find the load per square foot* of wing.

The load = 6 lbs. for whole area,

therefore load per sq. foot $= \frac{6}{3{\cdot}75} = 1{\cdot}6$ lbs.

The motor in this case is therefore powerful enough for a model weighing in all 6 lbs., with wings 29" long.

N.B.—As the motor itself weighs nearly $3\frac{1}{2}$ lbs., it is too heavy. One with better weight efficiency is necessary.

APPENDIX G.

Calculation for a tandem machine for 250 lbs.—the wings to fly $2\frac{1}{2}$ lbs. per square foot.

(i.) *The area* of each of the four wings must therefore = 25 square feet.

(ii.) *To find l* we have by formula (Appendix A)—

$$l^2 = a\ m^2 = 25 \times 1{\cdot}83^2$$
$l = 9'\ 2''$.

(iii.) *To find the increase of pressure* due to the velocity of the tip of the wing compared with that of a Flying Fox with 20" wings :

$$v' : v' = 20^2 : 110^2$$
$$= 4 : 121 = 1 : 30{\cdot}2.$$

(iv.) *To find the velocity of translation* as compared with a Flying Fox.

The pressure is 30·2 times greater, and therefore equals 30·2 lbs. compared with 1 lb.

By the formula for resistance of air we have

$$R = A\ \frac{v^2}{441},$$
$$\therefore v^2 = 441 \times 30{\cdot}2$$
$v = 118{\cdot}4'$ per second
$= 118$ miles per hour.

(v.) To find the velocity of tip of wing up and down.

$vel = 9{\cdot}15 \times 144 = 1317'$ per minute
$= 15$ miles per hour.

Calculation of strains and power for a 9' 2" winged tandem machine (see Fig. 14) :

$l = 110$ inches
$w = 125$ for one pair of wings.
$x = 1$ inch as this will allow a stretch of $\frac{1}{2}$ inch for the springs.

Digitized by Google

$\frac{p}{2}+\frac{p'}{2}=\frac{4}{5}w$ to admit of a deduction for the weight of the wings, springs, motor, &c., referred to the centre of pressure.

(*a*) Strain on springs=S (for total both sides):

$$S\,x=\left(\frac{p}{2}+\frac{p'}{2}\right)\frac{4}{9}\,l$$

$$S=100\times\frac{4}{9}\times110=4888{\cdot}8 \text{ lbs.},$$

therefore strain on each spring=2444·4 lbs.

(*b*) Let w_4=load to be added for each pair of wings

$$w_4\,x=\left(p-\frac{3}{4}\text{ wt. of wing}\right)\left(\frac{4}{9}\,l-x\right)$$

$$w_4=(125-10)\left(\frac{440}{9}-1\right)=115\times48$$

$$=5520 \text{ lbs.}$$

(*c*) *Work for flight* is to raise 5520 lbs + the weight of the body through $\frac{x}{2}$ 144 strokes per minute.

$$\therefore \text{ work}=(5520+80)\frac{x}{2}\times144\times\frac{1}{12}$$

$$=5600\times63=3600 \text{ ft. lbs.}$$

=1 H.P. say for one pair of wings, therefore work for two pairs of wings to fly 250 lbs. is a little over 2 H.P.

APPENDIX H.

Calculation to see whether work would be increased if the wings were made larger for the 250 lbs. load, than calculated for in Appendix G.

Load=250 lbs. for the two pairs of wings at 2½ lbs. per sq. foot in Appendix G.

Taking the load at 1¼ lbs. per square foot instead, the area of each wing=50 sq. ft.

(i.) *To find l* we have (Appendix A)—

$$l^3=a\,m^3$$

$$=50\times1{\cdot}83^3$$

$$=12{\cdot}94'=12'\ 11\tfrac{1}{4}''.$$

(ii.) *Increase of pressure* due to velocity of tip vertically compared with that of a Flying Fox with wings 20″ long.

$$v : v'=20^3 : 155{\cdot}28^3$$

$$=1 : 60.$$

(iii.) Calculation for the strain on springs, &c.—

$$\frac{p}{2}+\frac{p'}{2}=\frac{4}{5}\,w=100 \text{ lbs.}$$

(*a*) Strain on spring=S for both sides.

$$x=\left(\frac{p}{2}+\frac{p}{2}\right)\frac{4}{9}\,l$$

$$S=100\times\frac{4}{9}\times155{\cdot}28$$

$$=6900 \text{ lbs. say,}$$

therefore strain on each side=3450 lbs.

(*b*) Load to be added to body for strain $=w_4$ say, then

$$w_4\,x=(p-\tfrac{3}{4}\text{ wt of wing})\left(\frac{4}{9}\,l-x\right)$$

$$w_4=(125-10)\,(69-1)=115\times68$$

$$=7820 \text{ lbs.}$$

(*c*) Work for flight is that required to raise 7820 lbs.+weight of body through $\frac{x}{2}$ 144 times per minute

$$=(7820+80)\frac{x}{2}\times144\times\frac{1}{12}$$

$$=7900\times6=47400 \text{ ft. lbs.}$$

$$=1{\cdot}43 \text{ H.P.},$$

therefore for two pairs of wings work equals $2\times1{\cdot}43$ H.P.=2·86 H.P.

By comparison with the work required by the 9′ 2″ wings, see Appendix G; for the same load it may be seen that the larger wings require more power to work them.

APPENDIX I.

SLIPS FOR LAUNCHING MODELS.

The slips are ordinary electrical bell indicators fixed in suitable wooden frames. These frames are suspended from an overhead horizontal wire H as shown. (Fig 11.)

The frame A is fitted with a slip catch as shown. On closing the electric circuit from the electric battery on the ground, the electro magnet of the slip catch C frees the catch and lets the model M hanging from it go free.

The model M is suspended with a thread *p* to frame B, and swings off like a pendulum with the wings spread open.

The momentum acquired by the model in its swing can be increased by lengthening the drop and distance apart of the frames A and B.

The frame B is also fitted with the slip catch, in this case the frame is in a vertical instead of a horizontal position.

Two heavy weights are attached to the bottom of it to keep it steady and vertical. Two are necessary so as to leave a gap between them for the pendulum thread to swing between.

A slip bar *b* rests on the slip catch C to carry a pendulum wire P; at each end of this wire P is a loop, the upper for slipping on the bar *b*, and the other for attaching the thread for suspending the model.

A cross bar *d* of metal is passed into any of the holes *e* as required in the frame B below the slip catch. The position of this bar *d* adjusts the angle of inclination for the throw-off of the model M.

The cross bar *d* is connected with an elec-

Digitized by Google

trical wire to one pole of the battery. The pendulum wire P is in electrical circuit through the coils of the electro magnet of the slip catch to the other pole of the battery.

When the flying machine model M is slipped from the frame A, the pendulum wire P in the course of its swing comes into contact with the cross bar *d*, and makes electrical contact with it. The slip catch of the frame B then operates and frees the pendulum wire, and lets the model go free on to the air.

The thread and wire P fall clear of the model as they are attached with a hook. This hook turns over and clears itself automatically.

The cross bar *d* is tried in the different holes *e*, *e'*, *e''* till the longest throw for the model is obtained with the wings kept distended.

It has been found that an inclination of $\frac{1}{8}$ gives the best result.

Andrée's Polar Balloon Expedition.

What may, without doubt, be described as one of the most daring and venturesome of journeys ever undertaken has been entered upon by Herr Andree and his companions. The balloon containing the bold explorers left Spitzbergen on July 11th, at 2.30 p.m., the wind then blowing from the S.S.W. at about 20 miles an hour. Various accounts of the start have been given, but it appears that in the somewhat gusty and unsteady wind blowing, the balloon shot up to a height of 300 ft. and then fell nearly to the level of the water, over which it rapidly travelled. In this first bound two of the three guide-ropes became detached, but there was plenty of spare rope in the car, and, as the photographs taken show, there appeared to be quite a sufficiency of rope trailing behind to give the desired effect. It is said that the effect of his was at once apparent, for though the wind was from the S.S.W., the balloon travelled if anything to the west of due north. It is in the action of these guide-ropes and sails that we must feel special interest, for should the voyage be happily successful, the general public will undoubtedly hail this as an invention solving the problem of aerial navigation! Such sentiments, indeed, we have already seen in print, but, of course, it is almost superfluous to point out that this system of balloon guiding is only applicable to the arctic regions or other wide uninhabited districts, where no damage could be done by the trailing ropes, which so limits the employment of a balloon thus fitted, that we doubt if equipments of this sort will often be used, however successful Herr Andree may be.

The only news we have at present of the expedition is that contained in the two pigeon messages, which were despatched within two days of the start, and give very little information beyond the fact that all was well. The balloon must by now be exhausted of sufficient gas to carry the aeronauts, but we will hope they are safe in some place whence they will be able to reach, on foot, some inhabited locality. It would be interesting to know what Herr Andree decided was to be done with the balloon when no longer capable of bearing its crew; but it is possible that after being relieved of the stores, and two of the aeronauts, the third might endeavour to travel further, and if he reached civilization first, report the whereabouts of the others. Or finally the balloon could be sent up by itself with despatches. But if either of these courses had been adopted, we should hope to have heard something definitely by this.

New Suggestions for Aerial Exploration.

Herr Andree's venturesome voyage having called attention to the great advantages of the aerial highway as a means of reaching the Pole, and other places difficult of access, several ideas have lately been brought forward for more efficiently utilizing this route through the air.

One of them originated, or is supposed to have originated, with Mr. Edgar Wilson, who proposes using a balloon, the temperature of the gas in which is controlled by a lamp. The descriptions he has published accord remarkably with a proposition illustrated in the Journal of the Royal United Service Institution for June, 1883. But it is very doubtful if much advantage is to be gained from this method, even if it practically answered. The upper currents of the air are too variable to be depended on for reaching any given destination. Mr. H. A. Hazen, of Washington, D.C., has suggested that in further attempts to reach the Pole or to cross the Atlantic by balloon, advantage should be taken of the fact that at heights over 6,000 feet, the winds are

Digitized by Google

thrice stronger than they are at the surface of the earth. At this height there would also be less danger from moisture freezing on the balloon. The longest balloon journey on record, that in 1859, from St. Louis, Mo., to Henderson, N.Y., a distance of 870 miles, was covered in 19 hours, at a height of 7,000 ft.

Whilst the subject is before the public, I may mention an idea that has occurred to me, though I have not yet been able to obtain sufficient data to be sure of its practicability. Let it be granted that the scheme adopted by Andree is good enough, except for the one important point that his gas will after a time give out. I would then suggest substituting a kite or series of kites for the balloon. The facts that we have to go upon are: That a kite can be constructed which will float in the lightest of winds. That a kite can be made large enough, or a sufficient number of kites be attached together, to lift a man. That if the string of a kite be attached to a moving object, such as a boat or cart, it will tow the same along, and remain flying in the air. Also (for I have recently tried the experiment) that this object may be a simple heavy rope. It would therefore appear not impossible to use a kite or series of kites instead of a balloon with trail ropes.

There is practically no limit to the amount of kite power which could be employed. We know that about 500 sq. ft. of canvas is sufficient to raise a man in an average wind. But there is no reason why, for such a purpose as is here proposed, we should not employ 5,000 or 50,000 sq. ft.

These kites then would support a car containing the men, stores, etc., and a heavy trail rope, or better, several ropes, would be drawn over the ice and water below. Steerage way could be obtained, probably with much more efficiency, after the manner used by Andree. The only condition to fear would be a lack of wind, but when this occurs it merely implies a halt, which would also practically be the case with a balloon.

It has been ascertained that, as a rule, the wind increases in velocity the higher we go, and that at 1600 feet up the rate is double that at 100 feet. As the leading kite could easily be maintained at the former altitude or higher, the kite apparatus should be able, as a rule, to travel faster than a balloon with guide ropes.

The kite would also possess the following advantages: No danger from fire, so that a stove could be more comfortably used. In case of accident, the poles and material of the kites could be converted into sledges or boats. The apparatus would be much less costly, and therefore, if crews could be formed (as they undoubtedly could), several expeditions could start at the same time, which could render one another mutual aid.

Then again, in the event of a calm region existing around the Pole, as has been suggested by some authorities, the kites if carried into it by some abnormal wind, could be packed and transported over the ice back to the windy districts, an operation impossible with a large balloon.

Altogether then, I see no reason why a kite-car with trail ropes should not be used in preference to a gas balloon.

B. BADEN-POWELL.

The New German War Balloon.

For some time past we have had more or less meagre accounts of the so-called kite-balloon on trial in the German army, the patent for which was referred to in our April journal, but now we are able to reproduce a photograph which gives a very good idea of its general appearance. The principal intention is not only to have an elongated balloon, whose end presents less resistance to the wind than the side of a spherical one, but to so slope it that its under side acts on the principle of the kite. In order, moreover, to keep the balloon tightly distended, so as to preserve its shape, a reservoir with a funnel-shaped mouth is added, into which the wind blows and keeps the whole apparatus firmly distended; the stronger it blows, the greater will be the internal pressure in this pocket. A kind of rudder-like attachment, consisting of a smaller balloon, is fixed behind, so as to keep the whole steadily facing the wind, while another auxiliary balloon is sometimes applied to retain the position. The volume of the main balloon is about 18,000 c. ft. When floating in the air its axis forms an angle of some 50 degs. with the horizon. This invention, which is the device of Capt. Parseval, of the German army, is said to most successfully fulfil its object, viz., remaining steady in strong and gusty winds. To anyone familiar with our own war balloons, however, this apparatus, with its numerous ropes and other attachments, appears most complicated and unwieldy. A balloon of this description is also said to have been tried for naval purposes at Kiel.

Digitized by Google



THE GERMAN WAR BALLOON. From the *English Mechanic.*

Digitized by Google



NOTES.

DAVIDSON'S "VOLATION" FUND.—Mr. George L. O. Davidson has written letters to several of the leading papers on "The Supremacy of the Air. Is Great Britain to have it?" He very clearly and concisely points out how aerial navigation may now be considered as entering upon the range of practical politics, and indicates the possible danger which might accrue, should any other nation discover how to construct practical flying machines. He therefore suggests the creation of a "Volation" Fund for the purpose of investigating the subject; and has more recently written to say that in response to this communication he has received promises of support to the amount of £700 "for experimenting in the direction indicated under the advice of experts." Mr. Davidson is to be congratulated on his endeavours to stimulate the progress of invention in aeronautics, but we shall be anxious to see in what manner the funds are to be expended.

A LIFE-SAVING KITE.—Capt. F. Spiers, a retired master mariner, has perfected a good kite apparatus for life-saving at sea. The kite consists of a simple oblong of oiled canvas stretched on a frame of two cross sticks. An ingenious drum, or system of several drums, is arranged to pay out the kite string followed by the life-saving hawser. Capt. Spiers has a working model, which he is prepared to show to anyone interested in this subject. And it is to be hoped that this humane invention will speedily be adopted.

STEAM FLYING MODEL.—At the sitting of the French Academy of Sciences, on July 5, M. Marey read a paper forwarded by M. Tatin, a noted aeronaut and engineer, and Dr. Richet, editor of the "Revue Scientifique," on steam aerodromes. Experiments with these machines are being carried on in emulation of those undertaken by Mr. Langley, the eminent secretary of the Smithsonian Institute, 10 months ago, in Potomac Bay, near Washington. The French experiments have been made at Carquenez, near Toulon. The aerodrome weighed about 70 lbs., or two and a half times as much as the American one. The power of the engine was about the same, a little more than 1 h.p. The French machine had two screws instead of The French machine had two screws, one in front and the other behind. The maximum velocity obtained by MM. Tatin and Richet was greater—namely, 18 metres (19.692 yards) per second instead of 10—but the length of their run was only 140 metres (153.16 yards), instead of more than a kilometre (1093.6 yards). The duration of the experiment was likewise only a few seconds, instead of more than two minutes. The French aerodrome had merely two lateral projections and a tail. The total breadth of the aerodrome was a little more than six metres, and the surface a little more than eight square metres.—"Invention."

THE DANGERS OF FLYING MACHINES.—The "World," in an article on human flight, falls into a widely-believed fallacy. It says, "If any statistician of a morbid turn of mind were to occupy himself in tabulating the catastrophes which have resulted from ill-starred attempts to grapple with the problem, within say, the last half century, the 'butcher's bill' which he would have to present would surely total up to a figure formidable enough to give pause to the most inveterate optimist on the subject." Without being in much of a "morbid turn of mind" we have carefully noted all such catastrophes. Putting aside ordinary balloon accidents, where no special desire to further the progress of the navigation of the air was involved, we can only remember four actual fatalities, De Groof, Lilienthal, Dr. Wolfert and his companion. Even serious accidents not incurring loss of life have been fortunately exceedingly rare. The same writer is evidently getting very far out of his element when he goes on to say "For all the sacrifice of life and labour, it has yet to be shown that we are any nearer to a controllable and reasonably safe method of air travelling than we were at the outset." Let him read up his subject before dashing into print!

WAELDE'S AERIAL PROPELLER.—We recently had an opportunity of witnessing a trial of this invention. The apparatus consists of what may be described as a pair of feathering paddle wheels, though each wheel is fitted with only three "floats," these consisting of a circular frame 3½ ft. in diameter, covered with cloth, pivoted on trunnions. These paddles are actuated by man power by means of endless chains, two men working pedals similar to those of a bicycle. The angles at which the blades strike the air are controlled also by endless chains, so that by means of a pair of levers the propellers can be made to thrust up or down, forwards or backwards. The present apparatus, which is but a large working model, is neatly constructed of steel tubing weighing about 115 lbs. It is suspended from one end of a beam, the other end bearing a counterpoise. In this way a good idea of its action may be obtained, though its exact power has yet to be determined. Mr. Waelde states that one man

Digitized by Google

can by this means lift 25 lbs., which though but a small portion of the total weight to be lifted, would be useful if the apparatus were suspended beneath a balloon. As for the amount of lift to be obtained when a suitable motor is applied, nothing is yet known, but the principle is undoubtedly capable of further development. Further details are given under heading of "Patents" (No 9108).

Lamson's Man-Lifting Kite.—Mr. C. H. Lamson, of Portland, U.S.A., has now succeeded in raising a man with his kite. This machine is somewhat on the principle of that of Hargrave. According to Mr. Lamson's description of his kite, it consists of four pairs of wing-like sails, ribbed fore and aft, and superposed in pairs, with vertical webs or keels at the end of each pair to prevent lateral swaying and to increase the stability of the machine. The spread of the wings is twenty-six feet, and the framework, including the bowsprit, is about the same. The frame is constructed of American spruce, as this wood is said to be the toughest and lightest of any found about here. The sail fabric is of woven Berckley cambric, and the sails spread out on each side of the kite like the wings of a bird. The kite weighs about a hundred pounds, and the rider sits in a boat-shaped car, which is suspended from between the two sets of box kites. Attached to the bottom of this car are two bicycle wheels, by means of which the kite can be moved along the ground without danger of breaking the structure. The sails are so placed that when the supporting surfaces are folded down the kite may be moved about by one man.

Foreign Air Ships.—It is said that there are now three experimental machines being completed in Russia. At St. Petersburg, M. Okramovitch is constructing an aeroplane; at Kharkoff, Doctor Danilevski has a flying machine which is reported to be an object of astonishment to all the savants who have examined it; and M. Tchernouchenko also has an aerial vessel, which he hopes to try shortly. In Austria, Professor Schwartzmann is finishing a flying machine. In Germany, Herr Grussmann has a new airship and M. Fuvie, in France, is going to try a navigable balloon.

Who First Suggested Arctic Exploration by Balloon?—This is a question which has received some attention of late, but probably no one person can exactly claim the honour. When first balloons were invented, many writers pointed out that they might be of use for geographical exploration. When Green, more than sixty years ago, invented the guide-rope, such sentiments were reiterated. In 1876, Mr. C. Spencer sent to the papers a description of a balloon fitted for polar exploration, and in the same year Mr. Coxwell elaborated a scheme for Commander Cheyne, which would probably have been carried out, had sufficient funds been forthcoming. Indeed, this project gave rise to so much discussion that it may be said to have led to the various proposals since made. A Mr. Hutchins now claims to be one of the originators of the idea, having written an article on this subject in 1879.

Russian Aeronautical Exhibition.—It is proposed to hold an international exhibition of aeronautical apparatus in the summer of 1898 in St. Petersburg. The organizers are MM. Raukfuss and Knopp.

Recent Publications.

"*The Mechanics and Equilibrium of Kites*," by C. F. Marvin (Washington, U.S.A.). A monograph submitted in competition for the "Chanute Prize" offered by the Boston Aeronautical Society.

But a year ago it might be said that no scientific work on kites existed, yet in each of the four numbers of this journal we have had the pleasure of chronicling a new publication on this subject. The work now before us is indeed, from a scientific and theoretical point of view, quite the most exhaustive contribution. Professor Marvin goes deeply and thoroughly into his work, and carefully discusses the various effects of the wind pressures under all circumstances, the principal chapter being on "The Forces Acting on Kites," "Circumstances of Equilibrium," "Explanation of Flight of Kites," "Abnormal Flight of Kites," "Effects of Changes of Wind," "Condition of Stability and Steadiness," and "The Mechanics of the Kite String." But in this subject it is specially difficult to apply theory to practice. For instance, in this work, the author having elaborately discussed the position of the centre of pressure on a rectangular flat surface, owns that, "for the complex and multiple flat and arched surfaces usually found in kites, the position of the central axis cannot be located."

"*Meteorological Investigations in the Free Air*," by A. Lawrence Rotch, Director of the Blue Hill Observatory, Milton, Massachusetts, is a reprint of a paper read before the Boston Society of Civil Engineers in May last. After briefly recounting what has been done with balloons, an account is given of the cloud

Digitized by Google

measurements at Blue Hill, and details of the kite apparatus used at that establishment.

"*The Story of the Earth's Atmosphere*," by Douglas Archibald. (London: George Newnes.)

This handy little volume forms a most concise and succinct compendium of the Science of Meteorology in a popular form. Indeed it does more, for the chapter on "Suspension and Flight in the Atmosphere" is the one in which we are specially interested. A brief but comprehensive history of the balloon is followed by a short account of attempts to navigate the air, and a longer and illustrated description of kites and their uses. Though we notice one or two slight inaccuracies, such as the statement that Pilatre de Rozier in 1783 employed "ordinary coal gas" for his first ascent, we can thoroughly recommend this "nutshell full" of information to those who want to know about the atmosphere.

Foreign Aeronautical Periodicals.

L'Aéronaute (Paris), July: "The Destruction of Wolfert's Dirigible Balloon." (Full illustrated account.)

August: "The Aeroplane of Messrs. Tatin and Richet—from the Comptes Rendue and the Revue Scientifique."

September: "A Comparative Study of the Aeroplanes of Professor Langley and of Messrs. Tatin and Richet;" "Hargrave's Cellular Kites" (as in *Aeronautical Journal* for April).

La France Aérienne (Paris), 1—15 July: "Carelli's Dirigible Balloon." 15—31 July: "Air Ship, consisting of Two Elongated Balloons placed Side by Side, by M. Cruchet, and Criticisms Thereon, by M. Jobert;" "The Working of Captive Balloons," by Ch. Labrousse; "Recollections of the Siege of Paris" (continued).

1—15 August: "To the Pole by Balloon;" "Carelli's Dirigible Balloon;" "Balloon Ascents on the 14th July." 15—31 August: "Angelot's Paddle Wheel, and its Application to Aerial Navigation."

1—15 September: "Motors for Balloons;" "An Aerial Voyage;" "Siege of Paris" (continued).

Zeitschrift fur Luftschiffahrt (Berlin). May—June (the last received): "The Simultaneous Scientific Balloon Ascents of 14th November, 1896—Full Account of the Results;" "The Latest Experiments with Flying Machines," by Lieut. Hildebrandt; Illustrated Accounts of the Apparatus of Phillips, Wellner, Maxim, Stentzel, and Others; "Experiments with Large Aerial Screws," by G. Wellner, Records of Careful Experiments; "The 'Sporting' Balloon Ascent in Berlin."

Illustirte Mittheilungen des Oberrheinischen Vereins (Strasburg). The first number of the new publication of the lately-founded Upper Rhine Aeronautical Society. The first article is on the late Dr. Wolfert, with a photograph of his balloon. "Foldable Kites for Gliding Flight or Flying on a String" (illustrated); "Carrier Pigeons and their Use in Balloon Journeys" (illustrated); "Trials with Kites for Meteorological Purposes at Strasburg;" "Letters from Italy;" "American Experiments with Kites;" "Stentzel's Wing Machine" (illustrated).

L'Aeronauta (Milan), August—September: "Langley's Aerodrome;" "Italian Aeronautical Society;" "The Future of the Kite," an account of what has been done in England, America, and elsewhere; "Kite Balloon;" "The Theory of Aerial Navigation;" "Andrée's Expedition;" "Bird Flight;" Index to Vol. I.

Notable Articles.

July 2. *Mechanical World.*—"Aviation." Abstract of lecture by Mr. O. CHANUTE.

2. *English Mechanic.*—"Aerial Flight." F. H. WENHAM. Interesting article.

3. *Golden Penny.*—"About Flying Machines." 2nd Art. (Illustrated.)

10. *Saturday Review.*—"Flying Machines Next Century." G. L. DAVIDSON.

11. *New York Journal.*—"A Tale of a Kite." (Illustrated.) Lamson's Man-lifting Kite.

16. *Mechanical World.* "Aviation." Flight as effected by wind.

23. *English Mechanic.*—"Parseval's Kite Balloon." (Illustrated.)

23. *English Mechanic.*—"Aerial Flight." 3 letters.

24. *Saturday Review.*—"Flying Machines." Letter from Capt. BADEN POWELL.

24. *Invention.*—"Asbestos Balloons."

27. *Daily Graphic.*—"Herr Andrée's Expedition." (Illustrated.) General account.

Digitized by Google

30. *La Science Française.*—"La Roue Angelot." (Illustrated.) Description of invention for propelling balloons.
31. *Illustrated London News*—"Dr. Andrée's Balloon Voyage." (5 illustrations.)

Aug. *Knowledge.*—"Wind as an Aid to Flight." F. W. HEADLEY, M.A.

6. *English Mechanic.*—"The Aerial Problem."
7. *Black and White.* "The Andrée Balloon Expedition." Illustrated with a series of photographs.
12. *Nature.*—"Soaring Flights." (Illustrated.) Account of Mr. Pilcher's recent experiments.
19. *World.*—"Flights of Fancy."
21. *Saturday Review.*—"Has Andrée Found the Pole?" Capt. BADEN POWELL.
28. *Daheim* (Leipzig).—"Military Balloons." *Morning Post*, *Daily News*, and other papers have letters from Mr. G. L. O. DAVIDSON on "The Supremacy of the Air."

Sept. *Knowledge.*—"Wind as an Aid to Flight." J. H. MOXLEY.

Gentlemen's Magazine.—"Balloon and Kite in Meteorology." A. MAC IVOR.

3. *English Mechanic.*—"The Aerial Problem."
3. *English Mechanic.*—"A Method of Controlling the Temperature of a Balloon. (Illustrated.) E. E. WILSON.
4. *Glasgow Herald.*—"The Navigation of the Air: I." First of a series of interesting articles on the present state of the science.
9. *Saturday Review.*—"The Art of Flying." Letter from Mr. E. S. BRUCE.
11. *Golden Penny.*—"The Growth of the Balloon." (Illustrated.) Popular *resumé* of the history of Aeronautics.
11. *Science Siftings.*—"Andrée, Where is He?" (Illustrated.)
11. *Glasgow Herald.*—"The Navigation of the Air: II." Chiefly accounts of recent trials and experiments.
18. *Glasgow Herald.*—"The Navigation of the Air: III." Theory of aeroplanes and air curves.
18. *Golden Penny.*—"The Conquest of the Air."
24. *English Mechanic.*—"The Aerial Problem," "Controlling Balloons," &c.
25. *Glasgow Herald.*—"The Navigation of the Air: IV." Experiments in gliding, and conclusion.
28. *Western Morning News.* "Herr Andrée and Ballooning."

Applications for Patents.

15,987. July 5. ALEXANDER ADAMS, Sydney, N.S.W. **A Compressed Air Reciprocating Force Machine Designed to Assist in Producing the Up and Down Beating Motions of the Wings, or Carrying Surfaces of Machines Designed for Artificial Flight.**

18,663. August 12. ROBERT KRAUSS, Karlsruhe, Germany. **A Controllable Means of Aerial Transport as a Public Amusement.**

18,935. August 16. GEORGE HARDACRE, 322, High Holborn, London. **An Improved Flying Machine.**

18,992. August 17. WILLIAM BENNETT RULE, Montpelier Square, London. **Land, Marine, or Aerial Locomotive Engines.**

19,301. August 20. HENRY SHIPLEY BOOTH, 6, Bank Street, Manchester. **Improvements in Aerial Machines.**

20,434. September 6. CARL HOLLE, 22, Bloomfield Road, Bow, London. **Improvements in Aerostatic Vessels.**

20,909. September 11. WALTER THOMPSON and JAMES LYLE, 73, Basinghall Street, London. **Improvements in Inflating and Deflating Balloons or Kindred Air Vessels.**

21,308. September 17. ARTHUR ALEXANDER GOVAN, Dunvegan, Bridge of Allan, N.B. **Control and Propulsion of Air Ships.**

21,355. September 17. ALFRED GEORGE BROOKES. (PETER IRGENS BAGGE, Norway.) **Improvements in Balloon Steering Apparatus.**

Patents Published.

From the *Illustrated Official Journal.*

3657. **February 18, 1896. Aerial Machines.** ROOTS, J., 100, Westminster Bridge Road, London.

The machine is raised by a fan H on a tubular vertical shaft D driven by a motor, preferably an oil engine, carried in the car. A vane E prevents the car from being turned with the

Digitized by Google

fan, and a horizontal vane may control the inclination of the axis of the machine. Horizontal propulsion is effected by shifting the ballast so as to tilt the machine. The fan is composed of a tubular rim A1, braced by spokes A2, and with additional radial wires running from both ends of the rods A4 to the

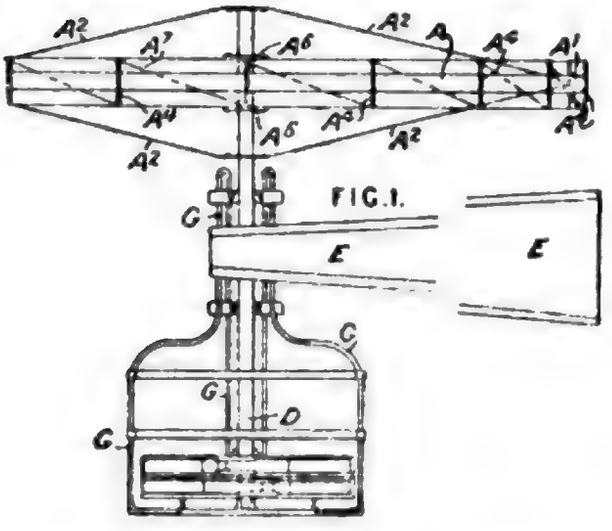


FIG. 1.

flanges A6; sails A7 are laced to these wires so as to set at an angle of about 20degs. The motor is cooled by the blast from the fan or by water carried in the tubular framework G. The fan acts as a parachute when not in motion.

5129. March 7. 1896. Aerial Machines. Scott, R., 168, Croydon Road, Newcastle-on-Tyne.

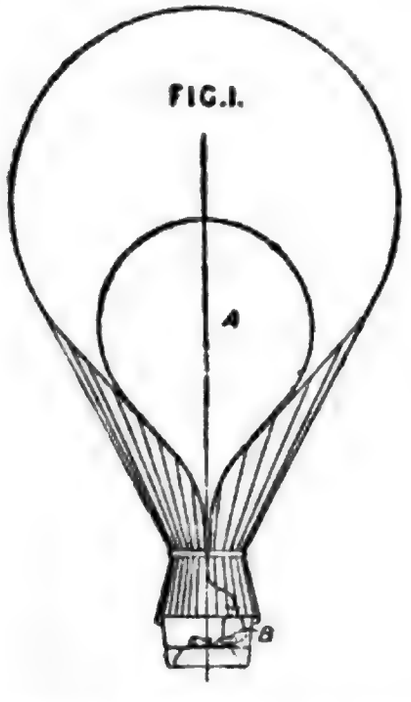


FIG. 1.

The attitude is regulated by varying the buoyancy of the aerostat. This is made to withstand a considerable bursting pressure and contains a flexible vessel A, which can be inflated with air by a pump B in the car when it is desired to descend.

9108. April 30, 1896. Aerial Machines. Warlde, J., 24, Broad Street, Golden Square, London, and Ahrlspies, J. F. C., 18, Tyndale Place, Islington.

The propelling apparatus comprises a pair of paddle wheels, the blades A of which are feathered by a chain passing round a pulley $b1$, on their axle a and E on the sleeve e respectively. The feathering, and consequently the

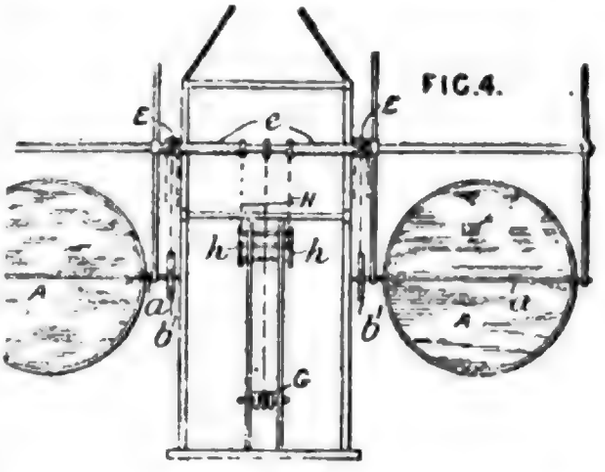


FIG. 4.

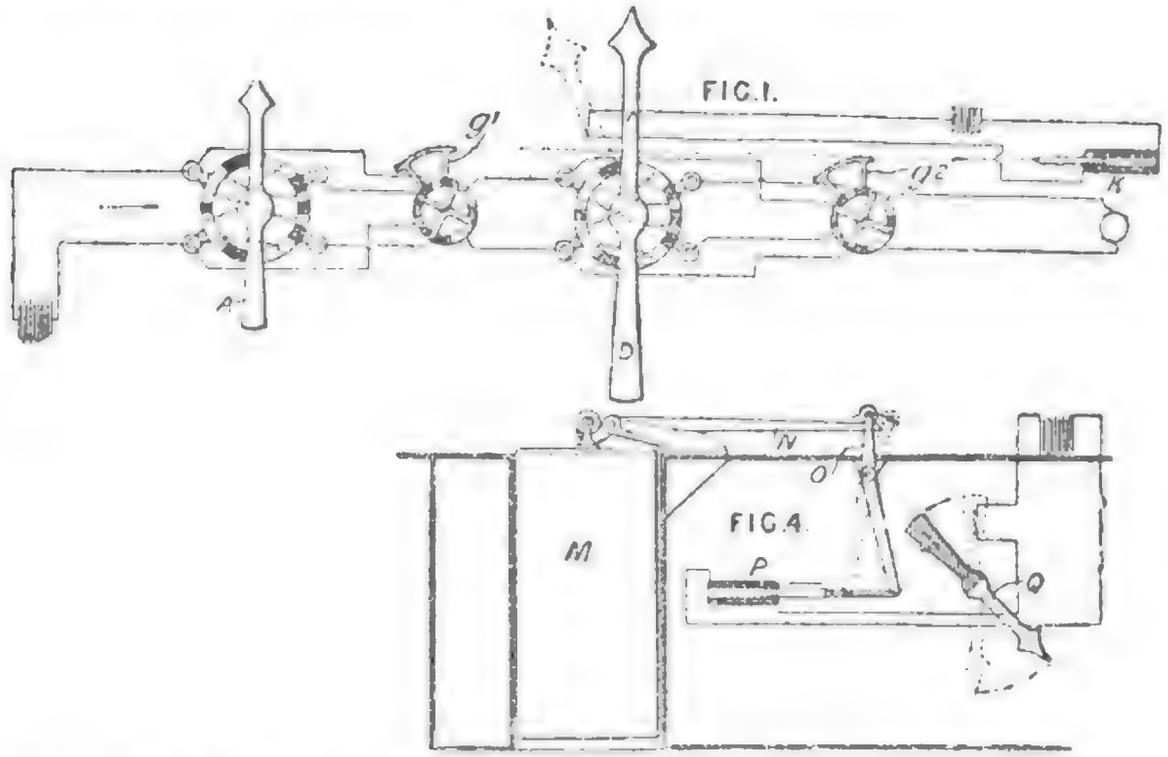
direction in which the blades make their effective stroke, is altered by turning the sleeve by means of a chain H and a lever working over a disc h. The apparatus is driven by pedals G, and may be attached to a balloon or used as above.

9142. April 30, 1896. Aerial Machines. Pennington, E. J., Racine, Wisconsin, U.S.A.

The invention is for automatically steering aerial machines and directing them towards large masses of iron, such as ironclad ships, and for automatic means for releasing bombs when immediately over such ships. Two magnetic compasses A, D are used which control, by electric means, the steering gear. A steers normally, and when the machine approaches an ironclad the needle D is deflected and completes an electric circuit through the coil K, by which the coil is drawn in, and the commutators $g1$, $g2$ are actuated for throwing the compass A out of, and D into, the steering circuit. D then takes up the steering, and directs the machine towards the ironclad. The bomb M, Fig. 4, is supported by a lever N, and released by the electro-magnet

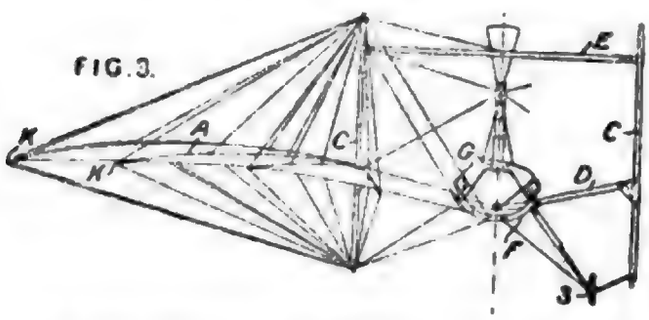
Digitized by Google

P, which withdraws the lever O. The current for exciting the magnet P is completed by a dipping needle Q, when it assumes a vertical position owing to the presence of an ironclad below it. The releasing lever may be actuated by a clock.



9144. April 30, 1896. **Aerial Machines.** PILCHER, P. S., Artillery Mansions, Victoria Street, London.

The machine may be used without a motor for soaring, or with a motor and propeller for flying. It comprises a tubular framework F with handles G, and of just sufficient capacity



to accommodate the aeronaut. On either side are carried masts C supported by rigid stays D,E, and from which radiate the ribs K of the wings A; these are stayed to the top and bottom of the masts. The wings have sleeves for the reception of the ribs, and are suitably lashed to their outer ends; they can be furled round the mast. Wheels 3, mounted so as to yield in a vertical direction, deaden the shock on landing. There is a horizontal rudder of about one-tenth the area of the wings, and steering is effected by the aeronaut altering his position in the car.

United States Patents.

586,590. July 20. **Air Car.** ADOLPH BRODBECK, Chicago.

Aerial Railway. Conical pointed balloon attached to rail.

588,556. August 24 **Air Ship.** THOMAS M. CREPAR, Grand Rapids, Minn.

Balloon with aeroplane round it, and "rocking" aeroplane.

589,373. **Traveller for Kite Strings.** ELMAR FOLSOM and EUGENE PACKARD. (Renewed.)

French Patents.

266,527. May 1. FRICKE. **Dirigible Aerostat.**

266,928. May 14. PAUBLAN. **Dirigible Balloon.**

German Patents.

APPLICATIONS.

P 7875. E. J. PENNINGTON, U.S.A. **Air Ship.**

P 8285. E. J. PENNINGTON, U.S.A. **Balloon or Flying Machine.**

Published by the Aeronautical Society.

"THE NAVIGATION OF THE AIR."

BY ALEX. McCALLUM.

Reprint from the *Glasgow Herald.*

PRICE (to non-members), 6d. [In the Press.

Digitized by Google

,205
1245

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF
AUG 4 191

THE

AERONAUTICAL JOURNAL



No. 5. JANUARY, 1898. VOL. II.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	1
THE GENERAL MEETING OF THE AERONAUTICAL SOCIETY	1
SOME AMERICAN EXPERIMENTS. O. CHANUTE, C.E. (*Illustrated*)	9
THE GERMAN ALUMINIUM BALLOON. Capt. MOEDEBECK (*Illustrated*) ..	11
FLIGHT AND HOW BIRDS SOAR. G. L. O. DAVIDSON (*Diagrams*)	15
MR. POLLOCK'S BALLOON TRIP ACROSS THE CHANNEL. P. SPENCER ..	20
NOTES: THE HIGHRST KITE ASCENT—A PARADOXICAL DESIGN—KITES AND ATMOSPHERIC ELECTRICITY—BENNETT'S APPARATUS—LECTURES ON FLYING MACHINES	22
RECENT PUBLICATIONS	23
FOREIGN AERONAUTICAL PERIODICALS	24
NOTABLE ARTICLES	25
APPLICATIONS FOR PATENTS — PATENTS PUBLISHED — FOREIGN PATENTS..	26

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

PUBLISHED BY THE AERONAUTICAL SOCIETY.



Reports of the Aeronautical Society - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

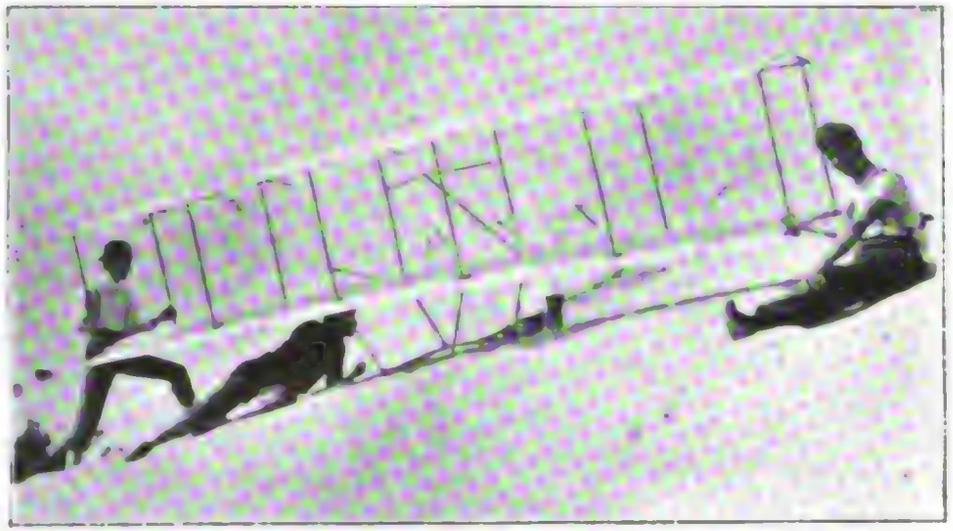
By A. McCULLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

CHANUTE'S GLIDING MACHINE.



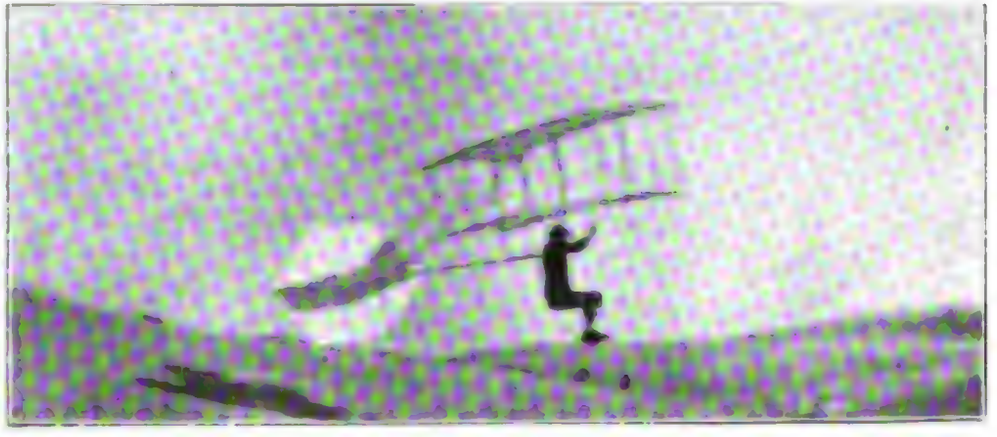
I.—GETTING READY.



II.—POISED.



III.—OFF.



IV.—STOPPING.

THE AERONAUTICAL JOURNAL.

JANUARY, 1898.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 8s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd.,
4, Bolt Court, 12, Gough Square,
and 4, Birchin Lane, E.C.

ADVERTISING TERMS:—10/- Per Inch, Single Column.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on Nov. 12th, when the following gentlemen were elected Members of the Society:—

Mr. WALTER BAGSHAW, J.P., M.I.M.E.
Sir JOHN CARDEN, Bart.
Mr. F. W. HEADLEY, M.A.
Mr. C. F. POLLOCK.
Mr. GEORGE L. O. DAVIDSON.

The following members were elected to the Council:—

Dr. L. EARLE, M.D.
Mr. PERCY S. PILCHER.

A Meeting of the Council was held on Dec. 16th.

A General Annual Meeting of the Society was held on Dec. 16th, at the Society of Arts.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

The General Meeting of the Aeronautical Society.

A general meeting of the members of the Aeronautical Society of Great Britain was held on Thursday, December 16th, in the hall of the Society of Arts, Adelphi. Sir Charles Warren, G.C.M.G., K.C.B., R.E., occupied the chair. Among others were present Sir Arthur Blomfield, A.R.A., Commander Tupper, R.N., Major Roberts, Capt. Heath, R.E. (commanding the balloon section), Mr. E. A. Barry, Dr. Earle, etc.

The proceedings commenced with a statement by the Honorary Secretary (Capt. Baden-Powell) as to the satisfactory condition of the Society, and some extracts of letters from Mr. Glaisher and from Mr. Coxwell, expressing regret at not being able to be present, were read. The following addresses were then delivered:

MODEL FLYING MACHINE.

Major Moore,—Ladies and Gentlemen,—The model which I exhibit is constructed in imitation of a flying fox, so as to investigate its powers and means of flight. Flying foxes fly for long distances, and must not be mistaken for flying squirrels. The latter only glide into the air from an eminence. Foxes flap their wings like birds. In flight they make 120 to 180 strokes per minutes with their wings, with an amplitude of no less than 30 degrees, judged by the eye. They travel at the rate of not less than 14 miles per hour. The natural wing of this animal, when examined, is found to be rigid in itself along the front or leading edge, and flexible at the rear edge and tip. In the artificial imitation it is found necessary to reproduce a stay from the wrist to the shoulder joint. This diagram (referring to diagram) is the artificial imitation, and this is the construction, and to get sufficient strength I had to introduce a stay from this point to this point (indicating). In the first models made with these wings, clock springs and electro-motors were used to work the wings. When they were flapped, the wings gave a powerful driving and lifting force in the down-stroke, but this effect was more or less destroyed for obtaining flight in the up-stroke. To overcome this difficulty, I went to nature for further information, and in my next design I introduced springs to represent the pectoral muscles.

Muscles act like springs. They expand and contract when excited by an electric current, and so perform work. In

Digitized by Google

this way the pectoral muscles worked the wings. With springs fixed to the wings in the same position as the pectoral muscles, the weight of the body can be balanced against the leverage of the wings as when on the air. In this (referring to model) you will see I have springs here which balance these wings against the weight of the body. The point of attachment is believed to be the point of non-oscillation in all natural wings when the flying foxes or birds are flying in the air. In this diagram here, this is the point of non-oscillation, and is where the pectoral muscle in nature is attached to the humerus. By watching large birds carefully, it may be detected by the eye that there is a slight rise and fall in the body to alternate with the down and up stroke of the wings. This is shown to be what takes place in flight, both by Marey and Headley in their books. The body rises and the wings fall. By hanging the model at the points of non-oscillation, and straining the wings as when on the air, the motion for flight, as in nature, can be imitated mechanically by actuating the springs. If I suspend it at this point of non-oscillation, by actuating these springs, I can imitate the action of the wings as in nature. (Illustrating by model.) By an arrangement shown in this model a current of electricity can be made to operate the springs and make the wings flap. This I have frequently done in my studio, where I have a current and suitable arrangements. There is a difficulty in exhibiting that in a lecture hall. I should have to have an electric battery and larger wings than these to exhibit it properly. In nature the nerves take the place of the wires. The motor and springs may be likened to the muscles, the contact maker and breaker to the brain. In this model there is a small contact maker and breaker which acts on the current, and alternates this and so acts on the springs. The effect of working the wings when suspended is to produce a strong current of air in the down stroke which drives the model forward forcibly. We know from what Marey says at the conclusion of his laborious experiments, that it is this force produced in the down-stroke that effects flight.

In the case of this model, which weighs only 3 lbs., the strain on the springs is 57 lbs. or 28½ lbs. on each spring on each side. Special springs must be selected for the particular strain for any sized wings, as this would vary in every case. They must be tested practically with their load to give by their natural resilience and the right number of strokes and amplitude for the wings without being over-strained when actuated. Springs have a natural resilience varying with the load on them and their length. I have some springs here (illustrating). I have one spring, and another double the length. That spring (the longest) if I actuated it, gives a certain number of oscillations per minute. Those oscillations are 132 per minute. Well, now, if I hang this same weight upon the shorter spring, I get 200 oscillations per minute. I can do another thing. I can hang a lighter load on, and after a while I get 200 oscillations per minute. It would take too much time to count them; you must take my word for it. The number of strokes per minute for any particular spring and load is not effected by the amplitude. This depends upon the force exerted to actuate the spring. The work to produce flight is that necessary to actuate the springs when strained with their proper load, as when the wings are on the air. The wings must make the right number of strokes per minute, and be of sufficient amplitude. In the case of the flying fox, the strokes of the fox when in full flight, average 144 per minute. The amplitude is taken as not less than 30 degs. The power necessary increases on a sliding scale in the case of larger machines. For a fox the weight of a man the power required works out 1 h.p. for 125 lbs. Maxim, with his small experimental models, driven by a screw propeller, found that 1 h.p. was necessary for every 133 lbs.; but with his larger machines he only flew 22 lbs. per h.p. Wings are probably more efficient for driving than screw propellers, as there is a great loss of power by slip with the latter; also wings move a larger weight of air due to their spread with a slower motion than could be the case with the screw propeller.

As regards the making of a practical machine for flight, I am keeping the length of the wings in my design down as much as possible, without unduly reducing the area. For this reason I have two or more pairs of wings instead of one pair only. These I arrange in tandem to give longitudinal stability. For the motor, I intend to have one which need exert power in a vertical direction upwards only. It would be a simplification of a kind used for cycles, and can be much lighter. Lately a lot has been done with soaring or gliding machines. If the wings for these were made strong enough, as they could be by following my designs, springs could be added to them. These would enable a man to more or less flap the wings when gliding, and so ob-

Digitized by Google

tain a driving pressure. This is an experiment I should like to carry out if I could see my way to it.

The solution of the problem of flight is one surrounded by many difficulties, but if all those interested in the subject will combine to help its solution forward with reports on the results of their practical experience, there is little doubt it will be successfully solved in time. (Applause.)

BALLOON SIGNALLING APPARATUS.

Mr. E. S. Bruce,—I have on several previous occasions had the honour of bringing my system of electrical balloon signalling before the notice of this Society, and I have described pretty fully the different experiments I have conducted for the various Governments that have adopted the apparatus for the purposes of warfare. With the progress of time another use has arisen for electrical balloon signalling. It promises to be a valuable adjunct to scientific exploration in Arctic and Antarctic expeditions. In Polar expeditions the want of intercommunication is perhaps one of the most depressing deprivations which befall the explorer of the untrodden latitudes. In Dr. Nansen's recent expedition the want of some point of communication between the drifting ship and a party of explorers leaving the ship even only for short excursions was severely felt. If the crew of the "Fram" had had the means of raising a light high above the mast tops to some thousand or even five hundred feet, and moreover if this light could have been made to flash signals it would have acted not only as a beacon guide, but also as a means of communication to any party that had left the ship, telling them whether the ship had recommenced to drift, the direction of the drift, or any other news that might have been welcome. Much assistance would be given to any Arctic exploration by any system of balloon signalling—a model of which I have on the platform. I may mention that in adapting this electric balloon to Arctic wants I have introduced some slight modifications in the apparatus. I have hitherto made my balloons of thin varnished cambric. For Arctic work, however, I have selected another material—gold-beater's skin—of which that model balloon is made. I have selected gold-beater's skin on account of its lightness. The cambric signalling balloon I made for use in war had a diameter of 14 ft., and a cubic capacity of 1,600 ft., and this took to fill it about 14 tubes of compressed hydrogen, these tubes being about 8 ft. in length and about 8 ins. in diameter. Now the smallest practical signalling balloon made of gold-beater's skin would be 7 ft. in diameter, and it would have a cubic capacity of about 150 ft., and it would take a little over one tube to fill it, as compared with the 14 tubes to fill the cambric balloon. An Arctic explorer would probably have a balloon a little larger, with a little more lifting power, so as to get greater altitudes if he wishes—perhaps a 9 ft., or even a 10 ft. balloon. The apparatus consists of a balloon, in the centre of which there are several incandescent lamps. These are in connection with an electric circuit on the ground, and on the ground there is an apparatus for making and breaking contact rapidly. It is something like a Morse key, such as we use for telegraphy, but it is essentially different, an ordinary Morse key would not stand the currents necessary for lighting the electric lamps. They have two forms. This is the form I have supplied to the British Government, and I consider it is the best form of key. The Belgian and Italian Governments are now adopting my system, and using this latter form of key. If I depress the key, the lamps in the globe become illuminated, and by depressing long or short we can make signals thus (illustrating). There is an apparatus or switch by which the light can be turned continuously on to the balloon, so that it might be used to act as a beacon light to any party who wanted to know the position of the ship. I may mention that a second use has been found for the electric balloon lit up in that way. It has been sent up a short distance from the ground, about 20 ft.; it gives a diffused light over a large area, and it is found possible to carry on work by this light. Perhaps in Arctic work it might be used for the same purpose. They might send the balloon up if they wanted to dig a ship out of the ice, or anything like that. That is a secondary use, but it shows what a diffusion of light we can get by placing the lamps inside the balloon. Besides being useful from the decks of Arctic ships, it would probably be very useful at Arctic stations, which are now becoming a prominent feature of Arctic expeditions. In the case of that carefully planned and scientifically equipped expedition from the Station of Elmwood, if such a balloon as this had occasionally arisen from that station there is no doubt Dr. Nansen would have been aware of the presence of friends long before he heard that welcome dog-bark. (Applause.)

Digitized by Google

KITES FOR LIFE SAVING.

Mr. Speirs,—My father has requested me to act in his stead, and to explain our model. It has been his object, if possible, in the case of shipwreck, to get a suitable and effective apparatus that will carry a line to the shore without the crew of the shipwrecked vessel awaiting assistance from the shore. And after considering all the possibilities of such a case he has come to the conclusion that the kite is the most simple and effective means. With that view, he has constructed a very simple arrangement, as you see—an oblong kite with pockets at the corners to fit in two cross pieces. It takes about one minute to fix the kite up. From the top corner to the centre is fixed a bridle, to which the kite line is attached. When a vessel goes ashore on the lee shore, anything blown by the wind would eventually reach the shore. The whole apparatus is contained in a box which should be carried at the most convenient part of the ship, say on the flying bridge, so as to least obstruct the lines in travelling out. The kite line is held on a small drum, and a stronger, or hauling, line is contained on a second drum. The box itself is on a pivot, to allow free action to the wind. Now, assuming that a vessel has struck, and we wish to make communication with the shore. We will fit the kite together, and attach the kite line to the bridle of the kite by means of a toggle holding its surface to the wind, and it would eventually find its way. Each of the drums is fitted with a brake by which we can regulate the revolutions of the drum. Should the kite fall short, the man would simply check the brake, and the kite would rise again until eventually it reached the shore. Well, in paying out, the kite line being fitted with a small toggle, in its turn catches up a stronger line which would be conveyed to the shore. On the end of the second or hauling line you see there is a small toggle fitted on, and on to the side of the box there is a lead attached which insures the paying out of the line. Whilst the shore line is paying out, you take the ship end of the hawser and make it fast to the most suitable portion of the ship, either a mast or a staunchion. The first man can then step into the breeches buoy and start for the shore. As regard life saving that is all I have to claim for it. Then there is, secondly, communication between two ships in mid-ocean. Only a few days back a liner passed a vessel in a sinking condition, and with great bravery the boat's crew put off and rescued the crew of the sinking vessel. But circumstances might have been far different; the weather might have been boisterous, and it might have been sheer folly to send a boat out. Our contention is by getting to the windward we could get a line aboard, and fix up a hawser, and get that crew from the vessel that requires assistance without necessitating the risk of sending a boat's crew from the vessel. Then again there was an instance some little time back where a lighthouse keeper was sick, and needed a bottle of physic to put him right, and he signalled to that effect. However it was not forthcoming; and although they tried to go to his assistance, they could not effect communication. Now if we could only have got a line there, we could easily have sent a bottle of physic or a doctor to follow it. Another way in which it might be useful is for picking up a hawser from a tug, if a hawser wore out and snapped aboard a vessel which was suitably equipped with a kite, and there would be no difficulty in making communication with our apparatus. (Applause.)

The Hon. Secretary then read some extracts from a letter he had just received from Admiral Sir Arthur Cochrane, who said that he had written a letter to the "Times" in 1872, referring to kites as a means of communication with wrecks. The following extracts were read:—"During the Russian War in 1855, and when in command of a frigate, I was desirous of ascertaining whether vessels and forts in the sea, which were unapproachable by ships or boats, could be injured or destroyed by means of torpedoes, towed into contact with such bodies by means of kites. With this view I made numerous trials with large 12 ft. kites attached to floating bodies such as planks with percussion firearms upon them. The kites were flown as directly to windward of the ship to be struck 'as due allowance for the deflecting action of the tide would permit,' and, at a distance from it of about two miles, such was the accuracy of the course of the kite towing its torpedo that it struck the ship, or otherwise would have proceeded to sea, and the speed of the kite was so great that, though pursued in a powerful six-oared galley, under oars and sail, it could not be overtaken, nor did the kite 'run down.' These trials forcibly impressed upon my mind the immense advantage which might be derived from the use of kites as a means of towing manilla rope hawsers to the shore from ships, with a view of communication, and for towing persons to the shore from stranded ships. Many people, when shipwrecked, throw themselves into the sea, holding to spars, and are mostly drowned through being

Digitized by Google

washed to and fro by the backwash of the waves.

"Were they, however, to attach themselves to a kite rope, and so be towed to shore, a few moments would suffice to land them on the beach, where they could be promptly rescued. The crews of ships aground under high cliffs, 'having no beach' look upon their fate as hopeless; but by means of kites, ropes could be, so to say, carried to the top of the rocks and communication established. All merchant ships should be obliged to carry a certain number of kites. 'These can be made of many forms: conical, triangular, etc., and without tails,' having steel or wood frames with the canvas and rope attached ready for use. The practical methods of employing such kites would suggest themselves to all, if their use was authorised and enforced. In our training ships for boys for the mercantile marine, the art of skilfully using kites for such purposes, and the employment or handling of life-saving apparatus at sea generally, could be taught."

KITES.

Capt. Baden-Powell,—I think most of you are fairly well acquainted with the general system that I have been employing for utilising kites, especially for man-lifting purposes; but there are some of you, if not most of you, who have not actually seen the apparatus, and therefore, I have procured one of my kites to-night to give you an idea of its make. You will see it is very simple, merely three poles and a more or less hexagonal-shaped cover Here is a small model which shows you the method by which it is flown. You see here (indicating), there are two strings. I usually employ two if there is any necessity to make the kite fly steadily, that is during strong puffy winds, and for man-lifting I prefer two strings, because it makes the kite steadier, and, therefore, better for observation purposes. In calmer weather, however, one string is often sufficient, because the wind is then steadier as a rule. I have often been lifted to a considerable height on a single line kite. I won't go at all deeply into the subject now, because as far as general principles go I have already explained them pretty fully, and as far as the theory of the subject goes, I am preparing a paper to read in this hall early in February, which will go as deeply as I am able to go into the theory of kites and the practical working of them. Kites seem to be coming to the front more every day. In America great progress has been made; not only has the Weather Bureau of the United States adopted them for systematic meteorological observations, but also in the United States' Army, important man-lifting experiments have been made with most satisfactory results, and now I hear that experiments are about to be undertaken in the German Army with kites. It seems a pity that they could not have been used in the recent fighting in India. I have received a letter from an officer out there who is strongly of this opinion. An elevation of a few hundred feet would be most valuable to look out for detached bodies of the enemy, especially when they are posted about among rocks, and in places where they are difficult to see, when you are on the same level or below them. It is possible that, if they had had some method by which to overlook these parties, many lives might have been saved in this recent war. I hope during the next few days to have some more trials of my apparatus in the neighbourhood of London, and shall be very glad for any member of the Society to come down and witness them.

You can see now from these kites that it is a very simple form of apparatus, and you can also see how light they are. A kite like this one, which is 12 feet high, only weighs from 5 to 7 lbs. They vary slightly. I had some specially made light for light weather, and others made very strong for strong winds. As a rule four or five of them are sufficient to lift a man. I have tried as many as eight together; in calm weather it requires that number to lift a man. On the other hand, in very strong winds indeed, I have known one of these kites lift me off my legs. To this little kite I have attached a piece of paper in order to show the method by which the man is suspended from the kite. It was only suggested to me just before the meeting, when I was asked: "Are you strapped on to the kite?" This will give you an idea. There is a car hanging from the lines similar to a balloon car, and in that the man is practically comfortable. I generally use an open parachute over my head in case of the lines breaking or anything going wrong with the kite. Well, I think that is as much as I need tell you about kites at present; but I shall be very happy to show you any details afterwards, and you can examine the kites themselves. (Applause.)

SOARING MACHINE.

Mr. Pilcher,—Better than describing a soaring machine, I must ask you to look at the one overhead; that is the one I have done best in. The other day I cleared nearly 300

yards in it. Now the object of these soaring machines, or rather the use of them, is to learn how to manage the simplest and cheapest machine in the air that can possibly be made. They are flying machines without any engines.

How do you fly without power?—Well, you either get up at the top of the hill, you face the wind, take a run, and then slide off into the air, and make a decent landing if possible at the bottom, which require practice; or else, which is a rather more difficult proceeding, get up to the top of one hill, with a string stretched across a valley to the top of another, and are towed straight across the valley through the air. Now this machine takes a pull of between 20 and 30 lbs. to keep it in horizontal flight with me in it; and I weigh about 140 lbs., the machine is about 50 lbs., that is 200 lbs. To keep that in horizontal flight with 20 lbs. pull, means a pull of only about one-tenth of the weight of the machine.

Mr. Moy,—How many square feet?

Mr. Pilcher,—This one has 170 square feet, that is about 1.3 lbs. to the square foot. How do I hold the machine? There are some photographs here which shew the thing pretty clearly. I get into the soaring machine simply by slipping my forearms through those padded straps. Then I hold on to the two handles, so that I am simply supported on my elbows. I keep the machine well back on me when I am standing, so that there is too much sail behind and the wind simply spills the sails and does not lift me. If when standing thus, holding the machine well back, a puff of wind comes, and as it comes the apparatus is brought forward, the wind will lift one up. I have in this way, without running at all, been picked up 10 or 12 feet from the ground, and put down in exactly the place I left, without having any line attached, being perfectly free. A little work has been got out of the puff of wind, possibly also the wind had an ascending trend at that particular place. Many people argue that some of the birds manage to get work from the wind continually. The great difference between a human being and a bird is that we are most misshapen things for the purpose of flying; we expose an enormous frontage to the wind, whereas a bird is nicely shaped away; although I am rather proud of these machines, they are not nearly as smooth and nicely finished off as birds are.

Mr. Moy,—Have you tried the super-posed plane?

Mr. Pilcher,—I have a machine with super-posed surfaces in hand. I think single surface machines have been abused more than they deserve. I think I can do just about as well with a single-surface machine as has been done with the super-posed surface machines, that is to say, with one surface placed on top of another so as to keep down the dimensions of the machine. Lilienthal first introduced this type of machine about three years ago; he allowed me to fly in one of these machines of his. I don't think they promise to be any better than single surface machines. The great objection is that if with engines you lose forward speed in the air, the parachute action is very much less, and one will take a much more sudden dive before recovering forward motion. The great thing is to make a decent landing. When I have been going along quickly, I have broken this machine several times by not landing properly, that is to say, by touching the ground when I have had a big forward speed. In this machine I took the precaution to put these little wheels underneath, and they take a great blow. If they break, the bottom of the masts get into the ground, and the next thing that happens is—well, the thing turns over endways, and gives one a bit of a jar. The proper thing to do is to get well back into the machine; that is to say, you put on the brake very slightly, you cannot put it on quickly. You see that rudder behind; without that rudder you cannot handle the machine at all; it is much too slippery, it will go down in front, and then it will rear up, but the horizontal rudder being slightly raised makes the thing very much steadier, it keeps the machine from pitching suddenly. The thing to be afraid of is taking a header. You are not nearly so likely to go back the other way, though it is possible. Lilienthal once got too far back in the machine, lost his balance, and then had a bad accident. The little vertical rudder has a little bit of a weather-cock action. If the wind suddenly shifts, it swings the machine round to head the wind.

How do you steer the thing?—If you want to turn in the air you get on to that side of the machine towards which you want to turn; that is to say the machine will always turn towards the lower wing. If the wind shifts, and you get a puff from one side, get right over to that side so that the machine will turn that way and tend to head it. When you are once off in the air, it is the relative wind you feel; I mean the wind made in relation to you, not the real wind. Now I started this game about two years and a half ago. I had been working with Mr. Maxim for

Digitized by Google

some length of time, and I had some accounts of Lilienthal's experiments in Germany, and I thought they would be most interesting to try and copy, and to try and proceed further with what he had done. Unfortunately about a year ago he came to grief, and so I have been trying to do justice to him as a pupil—(laughter)—not in coming to grief, I hope.

This machine is made so as to fold up; you cast off these, and the whole thing folds backwards, and you can then wheel it about without much trouble. One sail goes one way, and the other the other the other, and it will then go into a comparatively small crate.

Again, what is the object of these experiments with soaring machines?—Simply, as I said, to learn to handle the cheapest and simplest machines in the air—a machine which if it breaks does not really matter much.

Now that I have learned to handle one of these thing more or less, I have got an oil engine in hand of about 4 h.p., which I think should be enough to keep me in horizontal flight. The pull on a line attached to the machine is between 20 and 30 lbs., the speed at which the machine floats is about 20 or 25 miles an hour. If you multiply that out you come to about 2 or 3 h.p. Consequently, I have been intending simply to put a screw propeller, driven by an oil engine, into the machine, and I hope in time what are now soaring machines will develop into bona fide flying machines. In this machine the screw would be placed behind me, that is to say in front of the rudder, in the after part of the machine, but right above the ground so that it cannot get injured. The engine would be placed in the front, and the shaft pass over my head. I am not quite sure whether I shall put the engine in this machine or in another; but not a larger machine. I cannot handle a larger machine; it gets too cumbersome. If we put a greater weight into the machine of a certain size, it only means that to float it you will have to sail faster: a limit has to come in somewhere. I have tried various machines, from 150 lbs. to 300 lbs.; but I find about 170 seems to be about as much as one can handle—otherwise a little bit of irregularity in the wind throws one all over the place.

Mr. Moy,—You will have an additional weight in the machine, therefore.

Mr. Pilcher,—The propeller does not weigh much—3½ lbs., and the oil engine will weigh about 40.

Mr. Moy,—I understand that Mr. Chanute is doing the same thing in America.

Mr. Pilcher,—Yes, Mr. Chanute told me he did not want to go on with an oil machine until he had done more experiments with the gliding apparatus, although Mr. Herring, who is now working with him again, particularly wants him to do so. They have had an oil engine, but they have had a little trouble in trying to get it to ignite. The screw is 5 feet in diameter, the pitch is about 4 feet, and about 3 ft. 6 in. in the centre. It is made of yellow pine, and covered with canvas, and is exceedingly stiff and strong. This machine, with the screw propeller and engine, would become a Maxim type of machine, the smallest possible kind to carry a man. I look upon it as a mistake to make anything bigger than one can possibly help, because the weight and expense, and the danger, and everything else seems to me to increase with the increase in size. (Applause.)

GLIDING MACHINE.

Capt. Baden-Powell,—This little machine you see here is a very small and roughly made apparatus compared with Mr. Pilcher's; but this is made with rather a different object. I wished to try for a certain result. When you are gliding down a hill with one of those machines like Mr. Pilcher's you are suspended in the air for a certain time, it may be only a few seconds. I don't know whether Mr. Pilcher has ever timed it, but sometimes one can, I believe, go on for about fourteen seconds. I wondered what would happen if you were propelled along by the wings. I therefore made this apparatus smaller, because I do not want to remain in the air fourteen seconds; it would do for my purpose if I could be there two seconds, that is to say, if I could run down a hill and give a jump and a couple of flaps of the wings, and in that way I should be able to get an idea of the effect of flapping wings as a propeller. But as a matter of fact I have not had any satisfactory trials with this machine. I only tried it once and found various little defects in it. I thought I would bring it here just to show you the general idea of the thing. I have some photographs here showing the method by which it is worked.

AN ALUMINIUM BALLOON.

Captain Baden-Powell,—I recently received a communication from Captain Moedebeck, a German artillery officer, in which he gives a very interesting account of the aluminium balloon. I daresay many of you have seen

Digitized by Google

accounts of it in the papers. This balloon went up in Berlin, and apparently came down very quickly, and they say the man who was working it only saved his life by jumping out. It sounds a curious way of saving his life, but that is what the papers tell us. It seems to be very doubtful whether it was a great success or a great failure. Captain Moedebeck says it was a great success; I will therefore just read some extracts from his account*.

The Chairman (Major-Gen. Sir C. Warren), —Ladies and gentlemen,—Before closing the proceedings this evening, I propose to make a few brief remarks. Before Mr. Pilcher gave his reasons for experimenting with these flying machines, which he has developed to such a great extent, I began to be filled with gloomy apprehensions as to our future domestic life. If persons are to be able to put on wings and fly about freely in all directions, we shall have to live like birds, in cages—(laughter)—we shall have to have a network put over our windows and gardens and orchards, to keep out the flying men of the future. But it does not appear that the work is going in domestic directions; the tendency is to develop the aerial machine rather in the direction of military science, and in regard to saving life. Now with regard to military matters: I think I was the first general officer to ascend in a balloon on active service. I took a balloon equipment to Bechuanaland in 1884, and I should like to say a few words on the subject to show you how easily the matter is arranged. The gas required was packed in steel tubes under great pressure, and the waggon containing this gas and the balloon was brought right away up from Cape Town by the railway to Hope Town, and then by waggon into Bechuanaland. When we arrived at Mafeking, where the experiments were made, we were about 4,000 feet above the level of the sea. The balloons were not originally constructed to ascend more than 6,000 ft., so that we had only the limits of 2,000 feet, and not even that with a heavy man. In going up in the car I found the balloon spun round too much for good observation of the country. Afterwards, when other experiments had to be made, I went up in the net without the car at all, and I took up a telephone with me—it was rather a heavy one—in order to communicate with the land as to the whereabouts of an enemy we were looking for; but the weight of the telephone prevented my using it successfully without the car. This military question of using the captive balloon in warfare, and sending down intelligence is an important point.

Then with regard to kites. To my mind it is a matter of great importance. They were used by Captain Baden-Powell in the New Forest manœuvres about two years ago, but unfortunately he was on the side opposed to me, and I had not any opportunity of securing his services. We were obliged to use high trees. I saw afterwards the work that was going on, and also I saw his work at the British Association at Norwich in the following Autumn, and I formed a high opinion of the usefulness of the invention. He has described it partly to you. The rope was first laid out and then the kites were attached. A man got into the car, and he was allowed to go up with a parachute above him, so that in case of the rope breaking he could break his fall by means of the parachute. I may mention that there were a great many men in the crowd who went up in the kite car one after the other, and they were taken up from about 50 feet, quite high enough to get an extensive view over a flat country. It is of the greatest importance sometimes in a military campaign that we should be able to get up to a height of 40 or 50 feet. I think really the question of these kites deserves encouragement, and Capt. Baden-Powell deserves very great credit for the perseverance with which he has carried out these experiments. He has practically overcome many of the difficulties that he has had to encounter, and kites can now be used practically for military purposes.

Then with regard to the balloons for signalling. I think it is of great importance that they should be fully developed and brought into the service. I am quite sure it would be of the very greatest use to us. You must all have seen also the importance of the other apparatus for life-saving. If an arrangement of that kind could be put into practical use it might save the lives of scores or even hundreds of sailors. (Applause.)

On the conclusion of the addresses, the members and visitors had an opportunity of inspecting the various exhibits arranged round the hall. Mr. Pilcher's great soaring machine was suspended over the centre of the hall. Captain Baden-Powell's smaller apparatus, simply consisting of a pair of bird-like wings of cloth stretched on a bamboo framework, stood against the wall at the back. Major Moore's neat-looking silk model flying-fox was to the right of the platform, and Mr. Bruce's signalling balloon occupied one corner, with Capt. Spiers' life saving apparatus near it. Capt. Baden-Powell's large kite was on one side of

* *Vide* page 11.

Digitized by Google

the room. To the left of the platform was the "Aeroscope" to show the course of currents of air impinging on plane and curved surfaces. The current of air is drawn up the tube by an electric fan driven by a Cox Generator. This latter instrument attracted some attention, it having been kindly lent for the occasion by the Cox Thermo Electric Company of St. Albans. In principal it is but an enlarged thermopile, which being placed over a gas jet or spirit lamp, gives forth an electric current of 4 amperes to 3 volts, and seems to form a most handy and cleanly method of obtaining electricity, eminently suitable for all experimental purposes.

A large artificial feather was also exhibited, which practically illustrated the great amount of resistance to be obtained from the air, when violently struck by such a surface. Many photographs were also shown.

A vote of thanks to the Chairman and to the readers of the papers terminated the proceedings.

Some American Experiments

By O. Chanute, C.E.

Probably few readers realize the advance which has been made towards a practical solution of the problem of aviation within the last eight years. It is greater than all that was accomplished during the preceding two centuries. Not only has the subject been rescued from the contempt brought upon it by past failures and eccentric proposals, but very able men—Langley, Maxim, Pilcher, Hargrave, and Lilienthal—have shown by their experiments and writings that man may fairly hope eventually to fly through the air.

Hundreds of failures during the last 300 or 400 years have well shown what arrangements will not answer, but the labours of these latter experimenters now enable us to forecast that success is most probably to be won with aerocurves, driven by screws or flapping propellers, actuated by a steam or a petroleum engine.

What is the best course to be now followed to make still further advance? Most of the above experimenters seem to have proceeded upon the assumption that it is practicable to evolve a complete flying machine at one operation, and to apply propellers and motors from the first, before we are quite certain as to the stability in a wind. I venture to differ from them in opinion, and to believe that it is better to divide the evolution of a dynamic machine into several stages; that is, first to solve thoroughly the problem of the equilibrium, under all conditions of flight and of wind, before complicating the question by the addition of an artificial motor. In other words, that safety and automatic adjustment must be secured in the air, with a full-sized machine carrying a man, actuated by the force of gravity alone, before any other power be applied. Full-sized experiments are clearly the most fruitful; they have been few, because of the danger involved, and yet Lilienthal showed by thousands of flights, until the very last in which a hitherto hidden defect brought disaster, that the safest agent of propulsion was gravity, and that the danger was greatly increased on the one occasion on which he attempted to add a motor.

Having determined to confine my own investigations to the one problem of equilibrium, I secured the services of Mr. A. M. Herring, a civil engineer and experimenter, and in the summer of 1896 we tested no less than five full-sized machines (one of them rebuilt) in gliding flights among the sand dunes at the south end of Lake Michigan, about 30 miles from Chicago. Hundreds of glides were made without the slightest accident. Indeed, towards the last, such confidence was acquired in two of the machines that all amateurs were welcome to try them under proper supervision, and it was evident that any young, active man could become a gliding expert in a week. The account of these experiments has been given in detail in the "Aeronautical Annual" for 1897*. Two machines were evolved, each of different construction, which are believed to be much safer than any hitherto produced. They measurably take care of themselves in flight, and tend to restore the equilibrium automatically whenever compromised by the wind. This is done in both constructions by reversing the principle of the Lilienthal apparatus, in which the man has to move to bring back the centre of gravity under the centre of pressure, whenever the latter shifts from any cause. In the new machines moving parts are provided to actuate the supporting surfaces themselves, or to change their angle of incidence automatically, so that the operator shall only intervene to do the steering, or to alight. It is not claimed that either machine is as yet fully perfected, and that the man does not have to move at all,

* "Aeronautical Annual," edited by Jas. Means, Boston U.S.A.

Digitized by Google

but the frequency and amplitude of such required movements have been greatly reduced, and it is hoped that they will be eliminated altogether.

The "multiple-wing" machine, so called, consists in four pairs of wings, superimposed and rigidly connected by bridge trussing. They are fastened at their roots to vertical rods, rolling upon ball bearings, which are attached to the central frame, so that the wings on each side may swing horizontally forward or backward, their movements being controlled and limited by springs. The object is that the operator shall remain in one fixed position, and that in case the direction of the relative wind changes, the wings shall automatically move to bring back the centre of pressure directly over the centre of gravity. There is another pair of wings at the back, with elastic rear surfaces, which acts as a horizontal rudder. The supporting surfaces measure 143.5 sq. ft., and the total weight is 33½ lbs.

The other machine was termed the "two-surfaced." It consists in two aerocurves rigidly connected by bridge trussing, to the rear of which is attached a horizontal and vertical rudder, the whole being provided with a regulating mechanism designed by Mr. Herring, the operation of which is such that when the direction of the relative wind changes, the apparatus alters its angle of incidence, and thus restores the coincidence between the centre of pressure and the centre of gravity. This machine made the longest glides.

Fresh experiments were made in September, 1897, in the same locality, with a machine built by Mr. Herring for an amateur, and again hundreds of glides were performed without the slightest personal accident. The novice did manage to injure the machine slightly once (repaired in 10 minutes), but he made quite a number of longish flights with no harm to himself. The machine was of the two-surfaced type, equipped with the Herring mechanism, and the photographs herewith reproduced, although each taken from a different glide, fairly represent the various phases of a single flight.



V.—OVERHEAD.

Fig. 1 shows the apparatus at the top of the sand hill, which is about 50 ft. high, and the

Digitized by Google

operator is creeping under, so as to place himself within the arm bars when the machine is lifted up. The apparatus is designed upon the principle of superimposing the surfaces, proposed in 1866 by Mr. Wenham, and the frame consists in a bridge truss, with vertical posts of spruce wood and diagonal wire ties, capable of sustaining safely about 400 lbs. at the centre. The length across the wings is 16 ft., and each is 4 ft. 4 ins. broad, curved to a concavity of one-tenth of the width. The sustaining surface is 131 sq. ft., and the total weight is 25 lbs.

Fig. 2 shows the apparatus poised in the wind, preparatory to a glide. This operation involves some dexterity and experience, as the winds buffets the operator, and tends to lift him up prematurely. This is avoided by keeping the front edge slightly depressed until the moment of springing into the air, which occurs after two or three running steps have been taken. When this has been done, the man is off, as shown in Fig. 3, and glides over the ground at about 15 to 40 ft. per second. If the operator has assumed the proper position on the arm bars, the regulating mechanism takes care of the fore and aft equilibrium, but if a wind gust strikes under one wing more than under the other, thus raising it up, the operator has to restore the balance by throwing his weight (the feet in this instance) towards the side which has been elevated. Fig. 5 shows the machine sailing along directly overhead of the camera. The glide continues nearly parallel with the slope, until the bottom of the hill is reached, and the headway stopped, as instanced in Fig. 4, by tilting the machine up at the front, when the operator alights upon the sand with almost no jar at all, generally having glided about 300 ft., at an angle of about 10 degs. Then the apparatus is carried back, to make another glide, for the sport is so fascinating that experts can hardly get enough of it.

These experiments are believed to set forth that the objections which have been raised to superimposing concave surfaces, and to placing the operator so low beneath them, are not well founded. It is thought, however, that with such an arrangement the apparatus must contain within itself some moving mechanism to restore the balance as fast as it is compromised, and I am beginning experiments with still a third method of accomplishing this object, not because the two already tested are not satisfactory, but because it is deemed more prudent to endeavour to evolve the very best method before a motor is applied.

The German Aluminium Balloon.

By Capt. Moedebeck.

(Translated from the German.)

In most circles, particularly amongst technical aeronauts, the opinion is widespread that the adherents of construction of aerostatical dirigible balloons are on a false track, and that their objects are fundamentally different from those who seek to solve the problem of flight by purely dynamical means. The great resistance of the air which the balloon has to overcome, and the unfavourableness of such a form of construction, is generally put forward as an insurmountable obstacle.

The balloon, as all must allow, has already gained a recognized position, and has become useful for military and scientific purposes, whilst the dynamical flying machine has proved that, with such modern technical ingenuity of construction as has been created by Maxim, and is represented by the first flying machine to carry three persons, anything may be expected of it in the future.

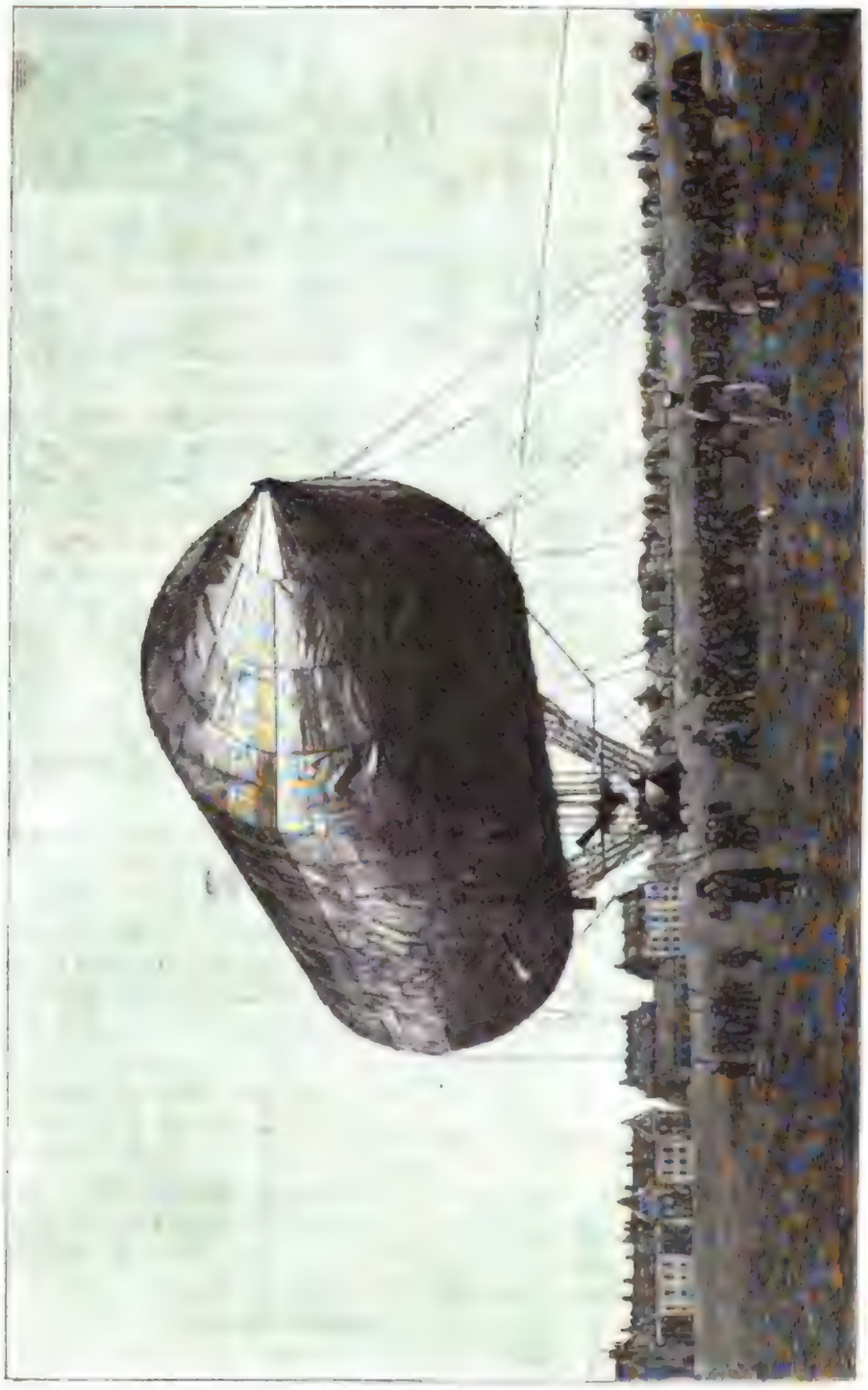
This belief in the future of the dynamical aerial machine is shared rightly by all aeronauts, but the development of it can only proceed (in the opinion of all practical and experienced balloonists) through the aerostatical balloon. The latter is an inevitable step in the evolution of aerial navigation. It represents to a certain extent the swimming belt for the aerial swimmers of the future, being provided with which they can learn to know the peculiarities of their aerial element, and find out how they have to behave in it. That supposition is also not right which some aeronauts hold, that an infallibly dirigible course can be kept by the balloon in almost any wind.

Practical aeronauts, as is often professed, have been content with a moderate speed, under the conviction that they would attain great results, provided only that they could, during hours and days, give to their vessel an independent motion.

One must quite give up the idea that a balloon could at once, like a railway, take up regular traffic. Such ideas are fancies which fly far beyond a reasonable limit. Given an independent motion of 8m. per sec., and our knowledge of the air currents are quite sufficient to make a useful scientific, as well as military, vehicle of the balloon. Certainly no one can fail to understand that as soon as

Digitized by Google

practical experiences are placed before us, improvements will follow naturally. Were we to enquire whether the dynamical flying machine corresponds to such requisitions, we must answer "No"; and in these days you would not even find an aeronaut who would risk himself in a vehicle exposed to such quite unforeseen casualties. It is quite the other way with the balloon. It represents a vehicle of which you can make use from the first. A proper motion of 6.5m. per sec. has already been reached (1884-5), but as the electric motor was only working for 20 minutes, the balloon which Capts. Renard and Krebs constructed was nothing more than a preliminary experiment. We now know that with our light motors we can easily reach that proper motion (6.5) during 10 or more hours. We think we may bring up the proper motion to 8m. per s., and hope to raise it in the end to 10m. per s. (equal to 22½ miles per hour), or even higher.



THE GERMAN ALUMINIUM BALLOON.

There would be no difficulty in obtaining the necessary driver and attendant in this case. The considerable number of well-trained aeronauts which Germany possesses would hardly refuse to welcome a balloon concerning which

Digitized by Google

all eventualities have been thought out, and ensured against, and, after repeated trials, to man it.

It will at once be clear to anyone what a prospect to balloon propulsion, and all the problems connected with it, opens up. In order to further the practical construction of an aerostatical balloon in a way which would answer the purpose, a memorable and interesting trial of a balloon, made entirely of sheet metal, took place on November 3rd, 1897, in the afternoon, between 3 and 4 o'clock, on the Tempelhof field in Berlin, which we will describe below. There is nothing new in building balloons of metal, and the idea has already brought forth a considerable literature.

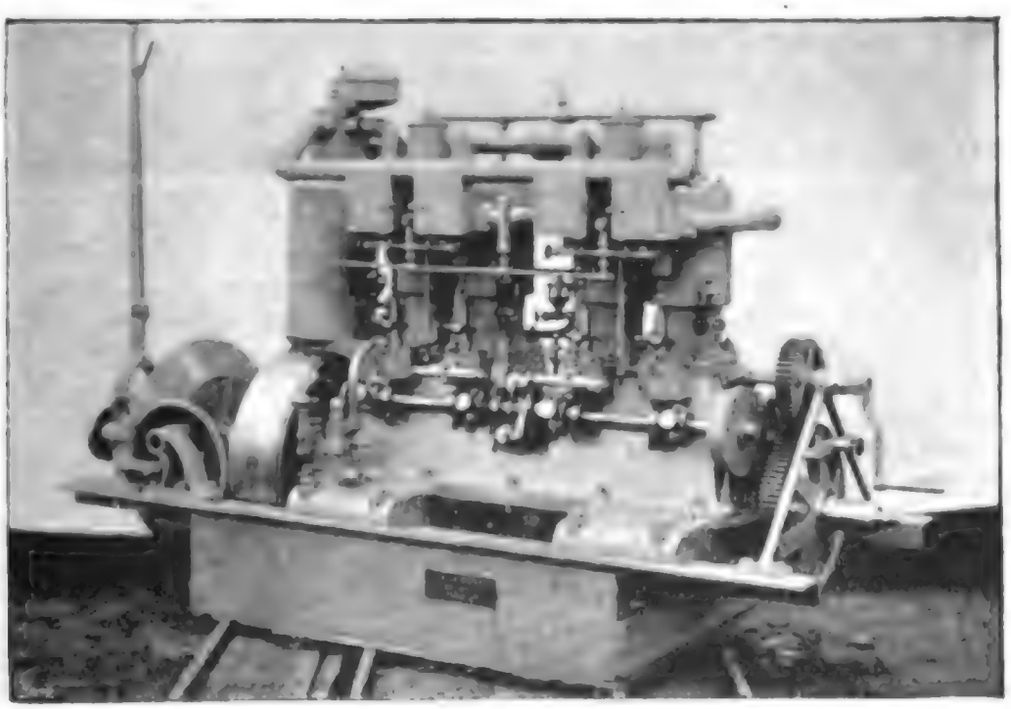
The first unsuccessful attempt took place in Paris in 1843, at the instigation of Marey Monge, by the aeronaut, Dupuis-Delcourt. They built a spherical balloon of sheet brass, of 10m. diameter, which, owing to its weight, could not rise.

The Berlin balloon was invented by the Austrian, David Schwarz, of Agram, and built at the expense of Mr. Carl Berg, in Ludenscheid (Westphalia), who also carried out the calculations and the construction of the vessel with the help of his engineers, Weispfennig and V. Watzesch.

and rigidly connected with the same by means of latticed supports. The body of the balloon



was 47.5m. (157 ft.) long, and had an elliptical section of 14m. and 12m. (46 and 39 ft.) axis length, with 132 sq. m. (1,452 sq. ft.) air re-



The shape is as shown in the illustration. The body of the balloon consisted of a framework, which was covered with sheet aluminium 0.2 of a millimetre thick. The bottom of the car was 4.5m. (15 ft.) distant from the balloon, sistance. The capacity equalled 3,697 cubic m. (130,500 cubic ft.), so that it is the largest airship hitherto built. The balloon was furnished with a four cylinder Daimler benzine motor, of 16 indicated, 12 effective, horse

power. The aluminium propellers had a comparatively small diameter. The two propellers at the sides of the body of the balloon measured only 2m. (6½ ft.), that in the middle, over the car, the shiftable steering propeller, 2.75m. (9 ft.) high; and below the car bottom, in addition, was a horizontal screw, which was not brought into requisition during the trial. The total weight (load) of the balloon was about 3,560 kg. (7,832 lbs.). The whole exhibited a masterpiece of German aluminium work. In filling it with gas, after the building in the beginning of 189/ was finished, some difficulties were at first encountered. Marey Monge, as is known, tried three methods during his trials, viz:

(A) Filling with water, and letting in the gas; only possible in practice with quite small vessels.

(B) Placing a stuff balloon inside the metal balloon, which becomes filled, and remains inside.

(C) Filling with gas through a tube which reaches up to the highest point in the balloon, pressing out the air by the lighter gas.

The latter process was used on this occasion. (See Zeitscrift fur Luftschiffahrt, 1885, p. 155.) On two occasions Schwarz failed in filling the balloon. Once the gas was not buoyant enough owing to mixture with air. The next time, through a tear from an unknown cause, the gas had escaped. The filling on November 2 was accomplished in 3½ hours.

With respect to the closeness of the balloon, trials in the factory had shown that even with 2½ atmospheres water pressure on the rivet seams, not an atom of water passed through. The loss of gas, therefore, on the following morning, notwithstanding the many thousands of rivet places, was hardly worth mentioning. They wished to have calm weather for the first trial, and thought they could count upon such from the state of the weather on November 2nd, when a high maximum was spreading over Europe.

Nevertheless, on the afternoon of November 3rd, a tolerably fresh wind, E.S.E., sprang up. The anemometer on the balloon establishment showed a steady pressure of 7.5m. per sec. (19 miles per hour). Notwithstanding this, the balloon was towed out of the hall, held by cables, on to the Tempelhofer field, and placed head to the wind. The aeronaut, Jagels, had mounted into the car, and at once



set the motor in motion. Various eye-witnesses informed us that, in fact, the vessel drove forwards, against the somewhat fresh breeze.

As they intended only to try a first experiment, they held it at first by ropes. The ropes broke one after another, and the vessel became free. As Jagels noticed his situation, he set the machine to a higher speed. Soon after his right hand propeller belt came off its wheel. The vessel in consequence turned 1¾ round on its axis, and was driven back by the wind. Over the barracks of the Railway Regiment No. 2, it seemed again to stand against the wind, just as the left propeller band was also blown off the wheel.

The rudder screw, which now alone remained, seemed not able by itself to overcome the resistance. When at last the band came off the rudder screw, too, the aeronaut opened

Digitized by Google

the valve, in order to land as near as possible to Schoneberg, over which place he was being driven.

He checked his rapid descent by throwing out sufficient ballast, and bounded up twice, which proved the strength of the framework, whilst the covering suffered tears, through which the gas escaped. At the third bump the balloon was thrown on its side on a hill, covered with bushes, between Wilmersdorf and Schoneberg, and remained so.

The stranded apparatus was eventually (with the exception of the framework) reduced to a complete wreck (Fig. 3), partly by the crowd which hurried round, pulling at it, and by the strong wind prevailing during the night of the 4th and 5th.

The trial, in fact, showed no decisive success, but gave a whole series of positive results, which must in every respect encourage procedure in working on in the given direction.

Success is exhibited in the sole fact that it has proved possible to construct, closely and strongly, a rigid riveted metal balloon weighing 3,565 kg., and of 3,697 cubic m. capacity, which could be sent up, and be driven forwards against a comparatively fresh breeze, even if only for a short time, in consequence of adverse circumstances.

Flight, and how Birds get a Rise out of the Wind when Soaring.

By G. L. O. Davidson.

This question has been so much discussed within the last few years, and so many are daily observing and studying the flight of every specimen of bird, that it is somewhat astonishing to me I have not yet come across any mention of the method which to my mind accounts for all the wonderful, and, to other theories, apparently impossible results of the ways of an eagle in air. I should be very glad to hear what objections can be raised to my explanation of how soaring is accomplished by any or all of the numerous writers and thinkers whose marvellous mathematical calculations enable them to account for some of the manœuvres of birds to their own satisfaction. I have not yet seen any description of a theory which claims to account for every movement of all birds, but it must be admitted if any theory falls short of that, it cannot be correct; whilst if it fulfils that condition it cannot be very far wrong. It sounds rather a large order to state that, having studied the subject of flight for 16 years, and observed the flight of many and various birds, I have never seen a single evolution or movement of a bird which my present knowledge of the laws of flight does not enable me to account for, and see, at any rate to my own satisfaction, how simply and naturally it is accomplished by the birds complying with those laws. It is another matter to successfully explain on paper the conclusion at which I have arrived, and as it would perhaps require more than a short essay to describe and account for the wonderful feats of active as well as passive flight, apparently at variance with the generally accepted rules laid down by students of volation, I merely propose to confine myself in this paper to "soaring," or what I have termed "passive flight." I do not think it has been so designated before.

I will now attempt to exemplify my theory by endeavouring to give a lucid explanation of one only of the feats referred to by Mr. Chanute in the "Aeronautical Annual" for 1897, pages 119 and 120, which he describes as "more difficult to account for," and I assert as a fact that the gull in accomplishing that particular feat, viz., rising higher than the starting point without flapping, extracted every particle of extra lift from a horizontal wind by the action of that wind upon the rear part of the wing curved downward beyond the angle of the line of direction in which the gull was cutting through the air, namely, the line made by the forward part of the curve of the wing and the tail. I would then say that I discard all ideas as to the necessity for birds taking advantage of any upward trend of the wind, and remark, that if a bird cannot rise in a wind which is not absolutely blowing downwards, it is not likely to be very proficient at soaring even if the wind is blowing upwards; and I therefore take the horizontal as a basis for the general condition of the wind in describing the action of soaring birds. Taking, then, the instance as given by Mr. Chanute of the gull perched upon a pile-head, 10 ft. above the water, facing a wind, which is described as blowing horizontally, at the rate of from 9 to 15 miles an hour. The gull, so it is said, opened his wings wide, took advantage of the greater speed of a wind gust, rose upward without beat of wing two or three feet, and travelling backwards a few feet, descended almost vertically about 9 ft.; then taking a forward movement, it rose again

12 ft., or say 3 ft. above the point to which it had risen on leaving the pile head, or a total rise of some 6 ft. without a beat of the wing.

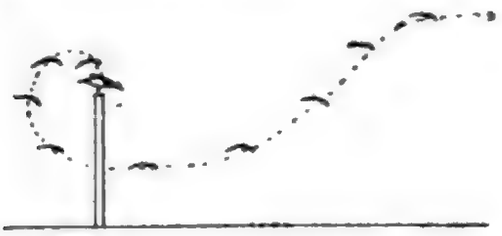


FIG. 1.—What Mr. Chanute describes as appeared to be the path of the gull over the water.



FIG. 2.—The course the bird must have taken through the air.

Mr. Chanute does not seem to me to have taken into account the fact of the air passing the point of observation, as well as passing the pile-head, thus making a difference between the true Fig. 2 and the apparent path of the bird through that air, Fig. 1. Another fact which I think Mr. Chanute has not reckoned upon, namely, that owing to the bird being perched upon the pile-head with its wings opened wide to the wind, it was, at the moment of leaving the pile-head, travelling through that air at whatever speed the wind was blowing, and thus had velocity with which to travel in an upward curve through the air, the fact of this velocity being not greater than the pace of the wind makes the bird travel backwards over the water, but all the time it is going forwards through the air slower and slower, until the velocity is nearly expended, and it then alters the angle of inclination by turning down its tail, and glides down an inclined curve, gathering speed as the force of gravity takes effect; but there again in the downward curve it appears still to travel backwards until it has regained a velocity equal to that at which the air is passing over the earth or water; then it appears to sink vertically until its velocity exceeds that of the wind, when it goes forward faster and faster, until, having as much way on as it desires, it again, by turning its tail upwards, commences another upward curve, which is continued if it so wishes until the force gathered from gravity in the downward glide is nearly expended. How is it, then, that the bird "soars," or without flapping, rises higher than the point from which it commenced to gather force by gliding downwards? It certainly is very difficult for any bird to do so in still air, nor do birds, except those with very much curved wings, attempt soaring in calm air, and it is admitted that the air is never absolutely at rest. If a bird could overcome gravity, not to mention the friction, (which, although all admit it is quite a small item in the air, yet it is an item which must be reckoned with), and, overcoming gravity, rise higher than the starting point without any lifting help from the force of the movement of the particles of the air, or without depending on any other force but gravity alone, it would, as someone has said, be a form of perpetual motion, and that, we know, is absurd; therefore the increase in rise must be got from the force of the wind, and to be of any practical value to a bird it must be got when it wants it, and consequently it must be able to depend upon a horizontal wind, or at any rate one which does not invariably blow downwards, and it certainly must not be dependent only on upward gusts. I therefore maintain that, by the fact of any wind catching the under and back part of the "sousface" of a curve projected against it, which it can only do when the back part of the curve of the wing is inclined slightly downwards, an enormous vertical lift is obtained without appreciably or proportionately retarding the speed of the projected curve, the point of inertia being near the forward cutting edge, and as also it is a fact that any wind, horizontal or otherwise, striking the convex surface of a curve when gliding downwards with the forward part inclined downwards, does not give any appreciable downward vertical push, nor proportionately retard the speed of the downward glide, so are the birds, by the difference between these two facts, able to take advantage of this vertical lift from the horizontal wind during their upward curve, and get a rise out of the wind without being affected by any corresponding hindrance in their downward glide, and without in any way altering the method of obtaining forward motion in calm or wind, which is done simply and solely by taking advantage of gravity, and using the force gathered by the downward glide, till it is expended by gravity and friction, should an upward or horizontal course then be taken, lifting being obtained in calm by the action of wings, and in wind either by the action of the wings or by extracting the lift from that wind as de-

Digitized by Google

scribed above, whilst starting in face of a wind is equal to having obtained in calm, by a downward glide, the same velocity as that of the wind the moment of starting.



Fig. 3.

The above rough diagram (Fig. 3) may give an idea of how the horizontal wind has no appreciable downward push during the downward glide upon any part of the aerocurve, whilst it may easily be seen how effectively a horizontal wind may act upon the hinder part during the upward projection, provided always that the point which gathers the momentum in the downward glide, and thus by its weight drags forward the whole structure in the upward curve; in other words, the point of inertia is towards the forward part of the actual aerocurve, the hind part of the aerocurve, upon which the horizontal wind has a lifting effect, because it projects from the cutting line of direction, being thus forced over the air, and not allowed to cut through it. I would here suggest how difficult it would be to control the direction of the structure in attempting to carry out this action by means of force from behind, such as propellers, with a push instead of a drag, or in any case where the heavy and active part has to follow the light cutting edge. Very little attention appears to me to have been given to the functions of the tail of birds, and yet we cannot help seeing that it is a very necessary part of the animal. In fact, I have held for the last 16 years, and still maintain more than ever, that the proper action of the tail is the main, if not the only means, of governing the angle of inclination of the outspread sustaining and cutting surface of the bird's wings, not to mention direction, with which the tail has a great deal to do. What appears at first sight simple, namely, the alteration of the centre of gravity, as in the case of the attempts of Lilienthal, Chanute, Pilcher, and others, at soaring flight, is, in my opinion, a most complicated and dangerous manner of preserving equilibrium, and, as far as I can gather, no one but myself has ever attempted the construction of any structure in which a properly controlled and properly constructed horizontal tail, governed automatically, is one of the essential parts. I leave to others to endeavour to calculate to a nicety the exact amount of lifting power to be derived from the wind by a bird of given weight falling with an estimated velocity at such and such an angle, against a wind blowing at a given speed, the wing of the bird having a curve of so many degrees, and I content myself with the fact that from observation I know that birds are able to gather more than ample force by allowing the weight of their bodies, supported by an aerocurve from a vertical fall, to glide downwards through the air, the convexity of the aerocurve offering so little resistance in the downward glide that the momentum accumulated in the body enables this body, which itself offers no more resistance to forward movement in the upward than it does in the downward glide, to drag the aerocurve forward through and over the air, and in such a position that the hind part is caught and blown upwards by the horizontal wind so long as it continues to travel in the face of that wind. I am convinced, also, from observation, that the soaring bird, although never flapping its wings, does straighten the hinder part in the downward glide, thus offering little or no resistance to the air when it is gathering the force of gravity, and in the upward motion it curves the hinder part out of the line of direction, and thus obtains the increased lift from the horizontal wind, which, catching that curve, blows the whole body upwards so long as gravity allows the forward motion through the air to continue.



Fig. 4.

I attempt to show this in Fig. 4, another rough illustration which I think will be admitted to be in accordance with what may be any day observed. No doubt in years to come we shall have beautifully-constructed soaring cars, which may be employed for flying race; up to some great height and down again, and where skill and practice will tell and win the race, but for practical travelling by air we must confine ourselves just at first to obtaining our lift mainly by means of a rotary substitute for the flap of such birds as the crow, and I absolutely disagree with those who hope to get practical results in flight with a run or a jump and a flimsy structure of bamboo,

wire, and canvas, although the data furnished by these workers towards the solution of the problem of flight must be admitted to be most valuable.

A more simple explanation of soaring I will endeavour to give in fewer words. As Mr. Chanute points out, all soaring birds have considerable curve in the wing, and he "is constrained to believe that birds of certain types do extract energy from horizontal winds." I say most emphatically that they do, and no one can satisfactorily account for soaring upon the assumption that there must be an upward trend in the wind whenever and wherever the millions of soaring birds daily and hourly desire to rise. Are all these soaring birds to seek out, according to Mr. Maxim, the ascending columns of air, and recognize them through their sensitive air cells, although these columns are generally, so he says, from 500 ft. to 20 miles apart? This sort of argument sounds to me very chimerical. I therefore repeat that all birds with a well-curved wing are able to extract an enormous amount of lifting power from a horizontal wind, even from a breeze of not more than four to five miles an hour, and in this way:—

1. The whole force for forward motion through the air by birds is obtained from gravity acting upon the weight of the body.

2. The body is formed to glide through the air with the least possible amount of friction, and no cutting surface but its point.

3. The path of the whole structure through the air is mainly governed by the tail acting as a horizontal rudder, hinged at D, Fig. 5.

4. The body is supported from a vertical fall by the air surface passed over by the outspread aerocurves or wings, the momentum of the body dragging the whole structure through the air, over a large surface, the weight of the body being balanced and supported at about the point A, Fig. 5. And here I may add that the larger the structure the smaller the proportion of air which will escape, and consequently the greater the weight which each square foot of air surface passed over will support.

5. The forward half section of the wings and tail are always in the line of the direction EE, Fig. 5, in which the bird cuts through the air.

6. The rear part of the wing curves downwards below the line of the direction of the cut through the air of the body, the forward part of the supporting aerocurves, and tail, and thus comes in contact with, and must be dragged over, the air coming from the direction of C, Fig. 5, and this curve is not allowed to cut through the air; consequently great pressure is created at point B, and causes a vertical lift affecting the whole structure, and thus gives the bird an upward line of flight, FF, Fig. 5, at a different angle from its line of cutting through the air.

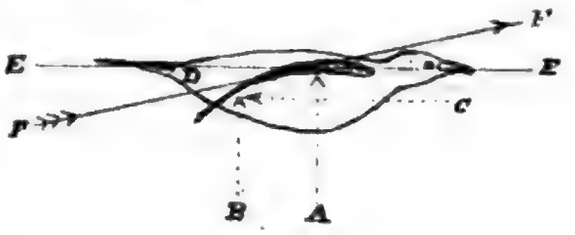


Fig. 5.

If the curve of the wing is great, as in the case of the hawk, the bird may continue to extract a considerable lift from the wind, or, in other words, be blown upwards by a horizontal wind, even when the direction of cut of the forward part of the wing and the tail EE is inclined downwards, and the bird thus retains its momentum by still being on a downward glide as regards its centre of gravity, although the horizontal wind is at the same time pressing it up and up on to different strata of air by the lift at B. It is thus a hawk hovers, it is thus soaring birds soar, and although my attempt at describing the theory may be faulty, and my explanations may be criticised, I am convinced the principle cannot be denied; and I should like to hear what mathematicians can make of it, for I feel sure many of those whose calculations I have read will be able to sit down and calculate the power extracted from the wind in this manner, right off the reel, although if they will insist upon relying upon wing square surface formulas, I think their calculations will probably be most misleading, and I would suggest that they pay a little more attention to the size and extent of the effective cutting edge of the aerocurves as being more reliable in practical volation; for, if the tip to tip measurement of a pair of wings be 10 ft., and their surface 20 sq. ft. or 40 sq. ft., they will only pass over the exact same square surface of air in the same time, say, 100 sq. ft. cutting through it at the rate of 10 ft. a second, and the 40 sq. ft. will give no more support than the 20 sq. ft., except for steadiness of flight.

As a cutting surface formula this may be a startler. The figures of the assumed first-named weight and dimensions may not be strictly accurate, nor can I explain what scientific principle is involved in the fact that the larger the structure the smaller the area of

Digitized by Google

air surface required to support each lb. of weight, and that there is no apparent fixed figure of necessary square surface per lb. weight, either for the wings of a bird or the area of air which must be passed over to support that weight, except the theory which I have already stated as to the larger the proportion of air which does not escape, the greater the weight it will bear per square foot; and I now state as one of the laws we must go by, that the air will support structures of a certain design (the design of a bird) up to any size and weight, so long as the structural (lineal, square, and cubic) dimensions are kept proportionate, the specific gravity of the whole being retained, and the action of the structure upon the air also remain proportionate, I mean as to speed. Upon this law it will be found, and I challenge anyone to disprove it in the fact, for the birds, which are as yet the only practical models by which we can calculate, will prove it, that, presuming the albatross has a cutting edge of, say, 10 ft., weighs about 20 lbs., and is supported when travelling over air at the rate of, say, 7 ft. per second; then, with a 2½ times greater in extent cutting edge, or 25 ft. tip to tip, and with a proportionate breadth, making the area equal to the square of 2½ times that of the area of the albatross (if you like, for the sake of stability), this structure will, if you increase the speed 2½ times as well, support the cube of 2½ times the weight of the albatross, or some 312½ lbs., although the surface passed over per second per lb. weight of the albatross figures out 3.25 sq. ft., whilst that of the larger structure figures out 1.4 sq. ft. of air surface passed over per second per lb. weight supported. We may form an idea of the capabilities of the larger structure for ourselves, even from the imperfect data furnished by the gliding machines already experimented with, and I distinctly state that a properly constructed aerocurve having a cutting edge ten times that of the albatross, or 100 ft. from tip to tip, passing over the air ten times the speed, or 70 ft. per second (about 50 miles an hour), will support a total weight of 1000 times that of the albatross, say 20,000 lbs., or 10 tons American. When this is admitted, despite the fact that it would only require .35 of a sq. ft. of air surface passed over per second per lb. supported, it will show what I have for many years contended, that it is no good trying to make too small a machine, and that to get satisfactory results we must go to such a size that we can afford to be clumsy, and have the requisite intelligence contained in the machine in the form of a human being whose weight of say, 150 lbs., is only a small item in a machine weighing 10 tons, but is proportionately enormous in a glider capable of raising only 300 lbs.

No doubt mathematicians will at once say in reply to these calculations that if we only go big enough the air will support almost any weight, and so it will, if the moving structure could be made in such a form that none of the particles of air could escape from beneath it, and the fact that the larger the air surface passed over, the less chance there is of the central particles of air being disturbed or escaping will, I think, be admitted to be a valid reason why those particles will give such a support under those conditions. What we therefore have to get at is the minimum speed required in practice to support each lb. weight by an aerocurve of a suitable form of given dimensions, and then we can rely upon it that with the same form and proportionately increased dimensions and speed, we get an equal support per cubic foot of bulk, which is the same thing as multiplying the weight by the cube of the increase in lineal dimensions. I have on various occasions heard it remarked that we cannot get away from the fact that for the same strength of structure we must increase the weight by the cube, in which case, if there be a fixed weight that each square foot of aerocurve surface will support, irrespective of the size of the structure, we could not provide supporting square surface for this enormous increase of weight in constructing a large machine. I therefore maintain that the weight which each square foot of surface will support increases also as the cube of the increase in dimensions, and that not only can we construct the outspread surface with material of sufficient strength, and yet keep within the proportionate weight of the bird's wing bulk for bulk, but that in constructing the body part we have such an increase in margin the bigger we make the machine, that we shall have ample room for engines of greater proportionate power than the internal power of birds, as well as room for human beings and reasonable freight. As I said at the commencement of this paper, I intended to confine myself to soaring, or passive flight, so will it be seen that all these calculations are within that category, for this 10-ton structure I have suggested is supported only at a speed of upwards of 50 miles an hour if it remains passive, and would require a much stronger wind than the gull to enable it to start passive flight from the top of a similar pile head as in Fig. 1. This stronger wind cannot, of course, be relied

upon for practical purposes, and consequently, although we may be able to construct a large machine which will continue in passive flight when once it is started, provided the speed of the wind by which it is able to soar, is to the velocity at which the gull is travelling through the air, in the same proportion as the speed of the wind which enables the gull to soar is to the velocity at which the gull is travelling through the air, it is not likely that the wind will often blow with sufficient force to allow a ten ton air car to start, or having started, to continue merely in passive flight. We must therefore consider carefully the conditions of flight in calm, and obtain an efficient substitute for the action of the wings of birds when starting in a calm, to enable us to start a 10-ton car in anything but a high wind. I have made calculations, based upon Nature's laws of flight, as I see them, which enable me confidently to state that it will be neither impracticable, nor even difficult, to so construct and work the larger air cars that they by their own power may rise in an absolute calm, and also descend and stop at any suitable place, whether the wind blows or not, and without any unnecessary or uncomfortable collision with the ground, for although, as is well known, the larger birds have much difficulty in starting in a calm, owing to the absence of room to work their widely extended wings, my mechanical substitute, lifting on the same principle, but with the suitable mechanical substitute for the intermittent action of the bird's wings, will not labour under the same disadvantage. One other point about which there is really no difficulty if the laws of flight are understood, and a most essential point it is, namely, the automatic stability of the whole structure. The air car I intend to construct when in funds will not turn turtle. In an ordinary wind it will, by automatic arrangement, glide smoothly and steadily along. I should not, however, be surprised if in heavy gales there may be a good deal of pitching and rolling, with the possible result of a new malady in the form of air sickness. I am now, however, wandering from the point which is the object of this paper, viz., to give a lucid explanation of the theory of passive flight, or how soaring is accomplished, and as I hope I have now made this fairly clear, I will close, trusting that those who admit the truth of my assertions will recognize the fact that I am the first to give expression to this theory, and that they will co-operate with me in my endeavours to continue experiments in this direction, and not take advantage of the new line of thought to which my assertions may give rise, and work it out independently of me. Funds are necessary, considerable funds, so as to carry out practical experiments. Engineering skill is also requisite, and I have great hopes I may be able to combine with others having greater engineering knowledge than myself, taking one man's engine, another man's material, and so on, combining a number of comparatively perfect pieces of mechanism, all acting in accordance and designed to comply with this theory which I have long claimed as mine, viz., that gravitation is the sole force employed by birds for forward movement, a theory which is based upon the laws Nature has laid down for mechanical as well as natural flight.

GEORGE L. O. DAVIDSON.

July 1st, 1897.

Since writing this paper I have (9th August, 1897) only just come across M. Mouillard's simile of the "roller coaster," vide page 158, "Aeronautical Annual," 1897, and find that it quite expresses the views I have held these 16 years. M. Mouillard does not say how the bird extracts the force from the wind which takes the place of the moving roadway. I have endeavoured to do so, but I think he does show in this way most conclusively that the force of the wind may attain the same result as the force of the moving roadway, and that, as the force of the moving roadway can be transferred into the body resting upon it, and give that body motion, so can the force of the wind be utilized by the bird resting upon it, if the bird goes the proper way to work, and is constructed to enable it to perform that work. So also will a mechanical appliance extract force from the wind if constructed in compliance with the requirements of Nature.

Mr. Pollock's Balloon Trip Across the Channel.

By P. Spencer.

Tuesday morning, October 12, 1897, opened out bright and clear at Eastbourne. At 6 a.m. no clouds obscured a perfectly blue sky, and a gentle breeze blew from the north-west. It was decided that the conditions were favourable for a balloon voyage to France. The grounds of Devonshire Park had been kindly placed at our disposal by Mr. A. Standen Triggs, Managing Director. The balloon had

Digitized by Google

been prepared for inflation overnight, and arrangements made with the Eastbourne Gas Company to be in readiness to turn on the gas if desired. This was done at 7 a.m., and the inflation proceeded satisfactorily until the balloon was full at 9 o'clock. The balloon had a cubic capacity of 35,000 ft., was nearly new, having previously ascended on six occasions only at the Crystal Palace, at Shrewsbury, and at Reading. These ascents had all seasoned the balloon, and a recent coat of varnish had rendered it gas-tight and in good condition. On the present occasion a small car, such as that usually used with balloons of 25,000 cubic feet capacity, was used to save weight. A trail rope of 250 ft. in length, weighing 80 lbs., was carried; a conical waterproof bag to act as a drag or sea anchor if required, and a Board of Trade cork life belt was in the car. Beyond these there were no further accessories than are usually provided with Messrs. Spencer and Sons balloons. Shortly before 10 a.m. the balloon was quite ready to ascend. The north-west breeze continued without abatement, and there seemed every prospect of a pleasant trip. It was found that the balloon would carry 14 bags of sand, with a total weight of 7 cwt., in addition to Mr. Pollock's weight, and even then have a satisfactory surplus of lifting power, say some 60 or 70 lbs. Mr. Pollock was provided with an aneroid barometer, with an altitude scale registering up to 20,000 ft., and one of Messrs. Phillips and Sons' maps of the English Channel. He also took with him a small handbag with personal requirements, in the event of his being obliged to stay for any time abroad, and a parcel of sandwiches and a bottle of claret. He took his seat in the car, and the balloon was released, and sailed aloft in the brilliant sunshine. It made a course almost directly towards the sun, which was then in the south-east. It was noticed never to bear to the west of the sun, but continued its course until about 11 a.m., when it was lost to sight of those who watched it from the sea front. I am now able to give the following particulars as told me by Mr. Pollock, from notes taken by him at the time. The balloon ascended at a uniform speed until an altitude of 4,000 ft. had been reached at 10.15. For the next half hour a grand view was discernible. The sun shone brilliantly, and the white cliff of Beachy Head stood prominent, and formed a land mark which easily permitted the bearings of the balloon's course across the sea to be taken with the assistance of the compass. For some half an hour the 4,000-ft. altitude was maintained, when the balloon began to descend, which necessitated the first sacrifice of ballast. Half a bag was thrown out at 11 a.m., when the balloon had descended to 1,700 ft. above the sea. At 12 o'clock the altitude was 3,300 ft., the balloon slowly rising, and at 12.10 the English coast had disappeared, though Mr. Pollock believes that he afterwards saw the white cliff of Beachy Head an hour later. At 12.45 the balloon had reached an altitude of 5,000 ft., and some marvellous cloud effects were visible. At 1.30 the French coast came in sight, and at 20 minutes to 2 it was noticed that the balloon was descending a second time. At 10 minutes to 2 the trail rope, which hung for 250 ft. below, touched the water. This enabled the course of the balloon to be checked by the compass. The ballast discharged caused the balloon to lift the trail rope out of the water, and at 2 o'clock the balloon had again reached an altitude of 4,500 ft., and was still rising. At 2.7 it was 6,000 ft. high, and at 2.12 7,000 ft., at which height the atmosphere was chilly. At 2.17 the balloon was 7,500 ft. high, and at 2.30 8,000 ft., at which height the windings of the French coast were visible for many miles. The bar of the river Somme was crossed at St. Valery, so that from coast to coast the trip across the Channel had occupied exactly 4½ hours. Between 2.30 and 4.30 the balloon passed across the French country, and eventually descended in a suitable ploughed field, the nearest town being Domart, which is 95 miles from Eastbourne in a direct line, and 25 miles from the French sea coast, the cross Channel distance being 70 miles. The average speed at which the balloon had travelled was therefore 15 miles per hour. Seven bags of ballast were left at the descent out of the 14 taken, so that there was an ample margin of carrying power in the balloon, which would have enabled the journey to be continued further overland had it been so desired.

Mr. Pollock was provided with English gold, but found that he should have exchanged it for French money before starting, in order to be provided with coin current in the country districts at the descent. He had, however, but little difficulty as to assistance, and shortly obtained a vehicle to convey the deflated and packed-up balloon to the St. Leger Station on the Chemin de Fer du Nord, where he booked to Calais, and crossed by the night mail boat to Dover, arriving at Victoria at 5.40 the next morning.

PERCIVAL SPENCER.

14, Ringcroft Street,
Holloway, London, N.

Digitized by Google

NOTES.

THE HIGHEST KITE ASCENT.—The general interest in scientific kite-flying leads me to send the following account of a flight here on September 19th, when meteorological records were brought down from the greatest height which it is believed a kite has yet attained. The experiment was part of an investigation into the meteorological conditions of the free air now in progress here, and which is aided by a grant from the Hodgkins Fund of the Smithsonian Institution.

A Richard baro-thermo-hygro-graph (described in "La Nature," 8 Fevrier, 1896), weighing but 3 lbs., was hung 130 feet below two large Hargrave kites, and other kites were attached at intervals to the four miles of steel wire forming the flying line, the total sustaining surface of the seven Hargrave kites used being something over 200 square feet. At their highest position the two topmost kites were 9,386 feet above Blue Hill, or 10,016 feet above sea-level. The altitudes, at short intervals of time, were obtained from angular measurements with a theodolite, and were confirmed by the barometer record of the meteorograph.

This instrument left the ground about noon, and the greatest height was reached soon after four o'clock, the meteorograph remaining more than a mile above the hill during five hours. A little more than two hours were required for the steam-winch to reel in the four miles of wire, and the meteorograph returned to the ground at 6.40 p.m. The wind on the hill blew from the south with a velocity of about twenty-five miles an hour, but veered to the west in an upper air. The chief results, obtained from the automatic records, which are smooth and distinct, are these: — The temperature at the highest point was 38 degs. while at the ground at the same time it was 63 degs., giving a decrease of 1 deg. per 375 feet rise, which is less than normal. The relative humidity at the ground was about 60 per cent. of saturation, but rose rapidly with height to about 4000 feet, which is the level of the cumulus clouds. It then fell, but rose again to nearly saturation above 7,000 feet, when approaching the level of the alto-cumulus clouds. The humidity fell to less than 20 per cent. at the highest point reached. Throughout the flight the sky was clear.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory,
September 23rd.

The highest kite ascent, described in "Nature" of October 7th, was in turn exceeded here by more than 1,800 feet on October 15th, when excellent meteorological traces (of which a facsimile is enclosed) were brought down from a height of 11,086 feet above Blue Hill. The flight was affected with only four kites, and the ascent and descent occupied but four and a half hours. Excepting a more rapid decrease of temperature with increase of elevation, the results agree with those already stated for the previous high flight.

I now desire to call attention to the fact that the deductions from our automatic records obtained with kites seem to confirm, in general, the conclusions reached by Messrs. Welsh and Glaisher from their observations in free balloons many years ago in England. For example, we find also that the most rapid decrease of temperature with height occurs usually in the lower mile of air during the daytime, and, even with no visible clouds that damp strata often exist in the dry air of the upper regions. A discussion by Mr. Clayton of more than one hundred meteorological records, obtained with kites since 1894, is now in the Press, and will form an appendix to Part i., vol. xlii. of the "Annals of the Astronomical Observatory of Harvard College."

A curious illustration of how identical methods sometimes may serve diametrically opposed investigations, is the application of the deep-sea sounding apparatus of Sir William Thomson (now Lord Kelvin) to bring down these aerial soundings.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory,
November 1st.

—*Nature.*

A PARADOXICAL DESIGN.—We have received from Mr. Alex. Adams, Assoc.M.Inst.C.E., of Sydney, New South Wales, a printed paper with reference to "Mechanical Flight." The author states that if a machine be constructed with beating wings, "it's flight may be indefinitely prolonged." He then adds: "Man, however, does not possess anything like sufficient muscular power to operate 'loaded' wings of 80 or 90 feet area." A diagram is given of an apparatus which is worked "without any exertion on the part of the occupant," and yet "no steam, electric, or other engine is required." We must own that we fail to understand the principle from the description given. It is stated that "the wings are free to elevate or depress with ease at the will of the operator, the action being from the feet off the shoulders." "Pneumatic pressure" is re-

Digitized by Google

ferred to, and it is added, "with such a device, a man can 'strike' the down-stroke with a force approaching a horse power."

KITES AND ATMOSPHERIC ELECTRICITY.—Lieut.-Col. Baudoin, writing in the "Bulletin de la Societe des Agriculteurs de France on "the Function of Electricity in Atmospheric Phenomena," brings forward the theory that clouds are formed of minute bubbles of water, or hollow drops formed by the electrical action of the atmosphere. This, he thinks, is partly proved by the fact that rainbows are never formed by clouds alone, but only by rain. He then describes how in China a large number of kites are periodically flown, and thinks that they, though usually regarded as playthings, have in reality the important object of bringing on rain. The kite strings are supposed to convey the electricity with which the clouds are charged to the ground, and the electrified bubbles then become drops of water and fall by gravity. He then mentions some experiments conducted in Tunis with a kite 10 ft. high, which caused a fall of rain each time it was flown. In 1894, a large kite was flown at Courbevoie, when a large cloud, estimated to be about 4,260 ft. high, came in contact with it. The whole cloud descended, forming a cone, and came to earth like a fog. On the kite being drawn down the cloud ascended again.

BENNETT'S APPARATUS FOR BALLOON STEERING.—A great deal has appeared in the papers about an old idea recently revived, of placing various screw propellers, to be rotated by manual power, about the car of an ordinary balloon. It has, however, been frequently demonstrated both theoretically and practically, that such a device is quite incapable of propelling a balloon at anything but a very slow rate, and as for causing a rise or fall, even if proved to be of use in this respect for practical purposes, a few bags of ballast are more simple and efficient. This apparatus has been on view at the Crystal Palace for some time past, but the actual demonstration has been postponed awaiting favourable weather.

LECTURES ON FLYING MACHINES.—Two lectures have recently been delivered, one by Mr. G. F. Charnock, head of the Engineering Department of the Bradford Technical College, before the Bradford Scientific Society, the second at the Hartley Institution by Dr. C. E. Cullis, M.A.

DAVIDSON'S AIR-CAR CONSTRUCTION SYNDICATE, LIMITED.—Registered on October 20th by Ashurst, Morris, and Co., 17, Throgmorton Avenue, E.C., with a capital of £20,000 in £1 shares. Objects: To enter into an agreement with George L. O. Davidson, to manufacture, sell, and deal in aerial or air cars and flying machines, and the parts and fittings of the same, and to carry on the business of mechanical engineers, fitters, founders, wire-drawers, tube makers, etc. The said vendor is the sole governing director. Qualification, 10 shares. Remuneration as the company may decide.

Recent Publications.

Abridgments of Patent Specifications No. 4. Aeronautics, 1884-88, has lately been issued by the Patent Office. This series of abridgments on all subjects, at popular prices (1s.), forms a most desirable aid to the inventor searching to ascertain the novelty of his invention.

The patent laws of this country make no provision for an official search as regards novelty, and all patents are taken out at the risk of the inventors. It is therefore incumbent on any person desiring to obtain a valid patent for an invention either to cause a search to be made, or himself to make a search, as to the novelty of his invention. By omitting such a search, many a patentee has found, after paying his fees, that his treasured patent is worthless, because it has been anticipated. Of course, in this case the first applicant or patentee possesses all the patent rights, and the second one has absolutely no rights at all.

A complete and exhaustive search through published specifications of patents is a task of considerable difficulty, even for the trained expert with all the resources of the Patent Office Library, for at this moment the number of printed specifications of patents is well over a quarter of a million.

A series of indexes and abridgments has been published by the Patent Office as a guide to the specifications themselves, and is freely distributed to the principal public libraries in this country. The abridgments give a general description of the nature of every invention patented, and the object of their publication is to enable the would-be patentee to carry out, at any rate in some cases, what may be termed a *fireside search*. By the study of these abridgments he will generally be able to select certain inventions which have already been patented, and which resemble his own invention sufficiently to render it desirable for him to examine their specifications in detail. A printed copy of any specification can be obtained at an in-

Digitized by Google

clusive price of 8d., through any Post Office, by a special postcard (Patents Form C'). The abridgments are published in volumes, each volume dealing with one particular class of inventions, such as "Steam Engines," and "Cooking and Kitchen Appliances, &c.," for a period of some years. The volumes up to 1877 are not illustrated, and all the subjects have not yet been dealt with, but from 1877 onwards a systematic series, very fully illustrated, is now in course of publication at a uniform price of one shilling per volume (including inland postage). The volumes for the periods from 1877 to 1883 and from 1884 to 1888 have been completed, those for the periods from 1889 to 1892 and from 1893 to 1896 are in active preparation, and later volumes will follow in due course.

Navigazione Aerea, by G. N. Da Pra (Milan: Ulrico Hoepli), is a small book describing a system of aerial navigation by a screw propelled plane. The general design is very similar to the old Henson machine, but there is also a second design in which there are two planes, like Hargrave's. A benzine motor is also described.

Herr G. Koch sends us an elaborate report on the problem of flight, profusely illustrated with designs and photographs, chiefly referring to his system of feathering paddle-wheels. We propose to fully notice this in our next number.

We have also just received an interesting pamphlet on "Gliding Experiments," by Octave Chanute, a reprint from "Journal Western Society of Engineers," giving a complete and succinct account of his recent experiments, fully illustrated from photographs.

Foreign Aeronautical Publications.

L'AERONAUTE (Paris), *October:* "Aerial Photography by Kite," by Emile Wenz. Illustrated by photographs and diagrams The advantages and disadvantages of Kites and small balloons for raising a camera are discussed, the only difficulty with the former being caused by lack of wind, the author laying it down that a wind of over 5 metres per second (about 11 miles per hour) is necessary, which, however, is a very high estimate. He then describes different methods of attaching the camera, and arranging the Kites, &c. M. Pesce in a letter discusses various aeronautical terms and considers Prof. Langley's word "Aerodrome" inapplicable in French. M. Nadar has offered his great collection of books, autographs, pictures, &c., relating to Aeronautics to the City of Paris.

November: M. Cailletet writes on apparatus for measuring the heights attained by balloons, and M. Violle on the actimometer. Accounts of several interesting balloon ascents are given, as a result of one of which M. le Cadet thinks that "the intensity of the field of atmospheric electricity diminishes as the height above the ground increases."

December: "The First Aerial Voyage of 24 Hours." Alphabetical Table of Communications published during 1897.

LA FRANCE AERIENNE (Paris), 1—15 *October:* "About dirigible Balloons," by C. Jobert. Signals. American News, "from our special correspondent in New York." "An Aerial Voyage," by Raymond Bouchard.

15—31 *October:* "The Action of the Sun on Balloons," opens up the question of whether light affects the retaining power of the envelope of a balloon. Certainly balloons kept indoors retain their gas longer than those exposed to light and air, also balloon voyages at night generally permit of a longer sojourn in the air; the effect of X-rays on the gas is also discussed. A memoir of M. de la Landelle follows.

1—15 *November:* M. Maret Leriche, honorary president of the Académie d'Aérostation writes "Acta, non Verba." An account is given of the voyage of the "General Chanzy" in 1870. "An Aerial Voyage" is continued. Extracts from Dr. Leon Germe's "Researches on Circulation, Respiration, &c., on Mountains and in Balloons."

16—30 *November:* The Ascent at Leipzig lasting 24 hours. The Voyage of "General Chanzy" is continued; the speed of the journey was nearly eighty miles an hour.

1—15 *December:* "Aeronautics from Day to Day." "An Aerial Voyage," continued. Dirigible Airship, C. de Gregorio. "Departure from Paris during the Siege," Godard.

16—30 *December:* "An Aerial Voyage," continued.

L'AEROPHILE (Paris), *June—July*: "Portraits of Contemporary Aeronauts—M. Frænkel and Lieut. Svedenborg": Lives and Portraits. "The Departure of the Polar Balloon." "The Catastrophe to Dr. Wölfert" (illustrated). "War Balloons" during the

Digitized by Google

Siege of Paris. "Experiments with a Steam Aeroplane," MM. Tatin and Richet. "Aerial Impressions." "The Third International Launch of Sounding Balloons." "Mr. Langley's Experiments."

August—September—October: "Portraits of Contemporary Aeronauts—M. Ed. Surcouf." "Long Aerial Voyages," discussing the employment of guide-ropes of various forms, sails, and "Mechanical Ballast" (illustrated), "J. P. Blanchard," "Electricity of the Atmosphere." "Apparatus to Measure the Height attained by Balloons," M. L. Cailletet. "Aerial Propulsion in Germany." Accounts of Experiments of Herr Wellner, of M. Sprengel, and W. Kress. "The Aluminium Balloon in Berlin." "Latest Notes of the Andrée Expedition." "The Great Captive Balloon at Leipzig," and the journey of 24 hours. "Crossing the Alps in a Balloon."

ZEITSCHRIFT FUR LUFTSCHIFFAHRT (Berlin), *July—August:* "The Simultaneous Scientific Balloon Ascents of 14th November, 1896." Full accounts, with diagrams, &c. "Fish Tails and Wing Flaps," by A. Samuelson. "The Laws of Elastic Resistance," E. Jacob. "Apparent Motions Behind a Plane Meeting a Wind." "Wind Pressures and Bird Flight," F. Ritter. All the above contain carefully worked out mathematical theories.

September: "Studies in Balloon Material," by Siegsfeld, with methods of testing, &c. "Dr. Wölfert," K. Müllenhoff.

October: "Dr. Leonhard Sohncke," "The Paddle-Wheel Flying Machine," G. Koch (illustrated). "Studies in Balloon Material," continued.

ILLUSTRITE MITTHEILUNGEN FUR LUFTSCHIFFAHRT (Strasburg), *No.* 2—3: "Andrée's Start," with two good photographs. "The History of Balloons for Polar Research," detailing the proposals of Meissel '66, Sivel '72, Cheyre '78, Hermite and Besancon '92, and Andrée '97. "The Action of Wind Currents on Clouds." "The Kite Balloon for Metrological Purposes." "The Flight of Register Balloons." "A Paddle Wheel Flying Machine," G. Koch. "Sport in Ballooning," by H. Moedebuk. "The Founding of a Manufactory for Light Motors and Flying Apparatus," A. Stentzel. "A New Motor," P. Meyer. Notes.

L'AERONAUTA (Milan), *November:* "Construction of Balloons," details of various materials. "Gas Engines." "The Compass in a Balloon." "Aero-dynamics and the Flight of Birds." "The Construction and Use of Balloons of Aluminium and of Brass."

Notable Articles.

Oct. *Science Progress.*—"Artificial Flight." Prof. G. H. BRYAN, F.R.S. An interesting article, including a brief history of the subject, and general discussion on the present position. The author gives the principal requisites as (1) powerful and light motor, (2) propellers and aeroplanes of sufficient lifting power, (3) balance and stability, (4) appliances for steering and controlling, (5) strength and rigidity, (6) means of landing. Each of these subjects is gone into at length.

Le Spectateur Militaire (Paris).—"Free, Captive, and Navigable Balloons."

Deutsche Revue (Stutgart).—"Rarified Air and Ballooning."

1. *English Mechanic.*—"The Aerial Problem." Several letters.
1. *La France Militaire* (Paris).—"Aerostation Militaire." Latest developments.
2. *Daheim* (Leipzig).—"Ballooning in Switzerland." (Illustrated.)
2. *Invention.*—"Polar Ballooning." H. E. HUTCHINS.
5. *Standard.*—"Experiments in Military Ballooning." Letter from D. Archibald, urging the superiority of kites for military work.
7. *Nature.*—"The Highest Kite Ascent." A. L. ROTCH.
9. *Golden Penny.*—"A Sky Bicycle." (Illustrated.)
12. *Daily Graphic.*—"German War Balloon." (Illustrated.)
13. *Times.*—"Military Ballooning." Recent experiments.
14. *Liverpool Post.*—"Military Ballooning."
15. *Engineering.*—"Scientific Ballooning and the High Strata of Our Atmosphere." Full and interesting account of the recent experiments with "sounding" balloons. (Continued in other numbers.)
16. *Revue Scientifique* (Paris).—"Captive Balloons." H. DE GRAFFIGNY. Long article on the history, construction, &c.
21. *Nature.*—"Aeronautical Ascents for Measuring the Electrical Field of the Air."
21. *Nature.*—"On Obtaining Meteorological Records by Means of Kites and Balloons." A. L. ROTCH.
21. *Rocket.*—"Up in a Balloon."
22. *Engineering.*—"Scientific Ballooning," &c. (Continued.)
23. *Black and White.*—"Across the Channel in a Balloon." (3 illustrations.)
25. *Pall Mall Gazette.*—"In High Altitudes." Experiments with kites and balloons.

Nov. *Century Magazine.*—"Andrée's Flight into the Unknown." (Illustrated.)

Scribner's Magazine.—"Aerial Photography." WOGLOM.

Le Spectateur Militaire (Paris).—"Free, Captive, and Navigable Balloons."

Memorial de Ingenieros del Ejercito (Madrid).—"Balloon Ascents."

Journal United Service Institution.—"Note on French War Balloons."

5. *St. James's Budget.*—"Mr. Pollock's Balloon Trip Across the Channel." (Illustrated.)
6. *Weekly Scotsman.*—"Aerial Navigation." Correspondence.
9, 10, 11, & 12. *El Nacional* (Peru).—Four articles on "Aerial Navigation," by J. V. LARRABURE.
13. *Illustrated London News.* "Captive Balloons in the German Army."
15. *Liverpool Daily Post.*—Leading Article, with extracts from *Aeronautical Journal.*
19. *Engineering.*—"Scientific Ballooning," &c. (Continued.)
20. *Illustrated London News.*—"German Aluminium Balloon." (Illustrated.)
20. *Glasgow Weekly Citizen.*—"Balloon Railway." (Illustrated.)
25. *Revue Technique* (Paris).—"Aerostation and Geodesy." M. Caltetet's invention.
26. *St. James's Budget.*—"The New German Aluminium Balloon." (Illustrated.)

Dec.
Atalanta.—"Military Ballooning."
6. *Nature.*—"The Use of Kites in Weather Prediction."
10. *Engineering.*—"Air Waves, and Their Effect on Balloons."
17. *Dublin Nation.*—"The Battleground of the Future." Discusses the possibilities of aerial warfare.
17. *Daily Chronicle.*—"Soaring Ambitions." General Meeting of the Aeronautical Society.
17. *Morning Post.*—"The Aeronautical Society." General Meeting of the Aeronautical Society.
17. *New York Herald.*—"Aeronauts and Flying Machines." (Illustrated.) General Meeting of the Aeronautical Society.
18. *Daily Graphic.*—"Argonauts of the Air." General Meeting of the Aeronautical Society.
28. *Morning Post.*—"Kites for Forecasts."

Applications for Patents.

23,563. October 13. W. P. S. EDWARDS, 4, Landport Terrace, Southsea. Improvements in Apparatus for the Navigation and Control of Balloons and Aerial Navigators.

23,655. October 14. S. E. STATHAM, Manor House, Levenshulme, Manchester. Improved Means for Preventing the Escape of Fluids from Balloons, &c.

24,133. October 19. W. J. BREWER, 48, Temple Chambers, London. Improvements in Aerial Navigators or Steering Balloons.

24,532. October 22. C. DANILEVSKY, Norfolk House, Victoria Embankment, London. Improvements in or Connected with Aerostats.

24,590. October 23. W. DOIG, A. DOIG, and D. DOIG, 174, New Bond Street, London. Improvements in Balloons and Balloon-supported Cars.

28,810. December 6. E. H. GREY, 261, Essex Road, Islington, London. A New or Improved Aerial Machine.

30,932. December 31. W. T. CARTER, Norfolk House, Strand, London. A New or Improved Method of and Apparatus for Propulsion Specially Applicable for the Propulsion of Torpedoes, Aerostats, and other Bodies Lacking in Stability.

Patents Published.

From the *Illustrated Official Journal.*

9,129. April 30, 1896. Aerial Machines. KOSCH, R., 60, Centre Street, Cleveland, U.S.A.

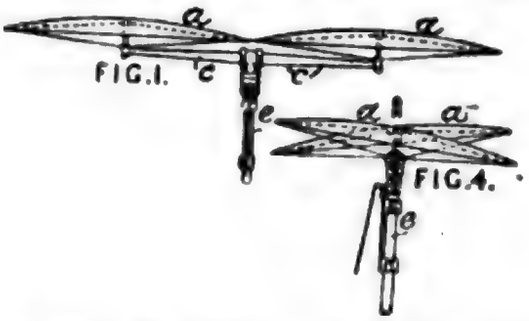
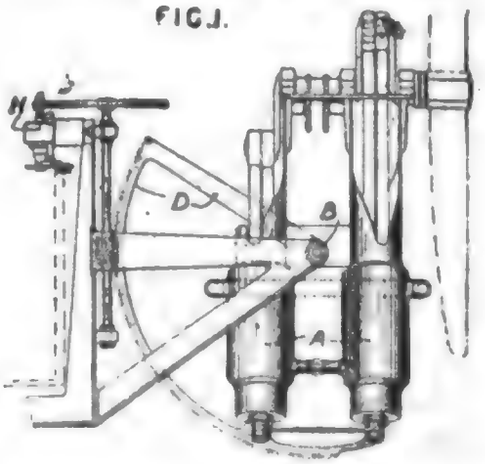


FIG. 1. FIG. 4.

For lifting the machine, the propellers shown are employed, and are made large enough to act as aeroplanes to support the machines. Each propeller comprises two wheels *a* constructed like velocipede wheels and covered with balloon fabric in such a way that the air pressure from below curves the fabric into a spherical shape. The wheels are mounted at the ends of arms *c* which revolve about the vertical shaft *e*. When it is desired to raise the machine, the planes of the wheels are inclined to each other by turning the arms *c* about their own axes, Fig. 4, when they act as a screw propeller. When they are to act as an aeroplane, they are turned into the same plane. Two propellers revolving in opposite directions are employed on each machine.

11,995. June 2, 1896. Aerial Machine PENNINGTON, E. J., Motor Mills, Coventry.

FIG. 3.



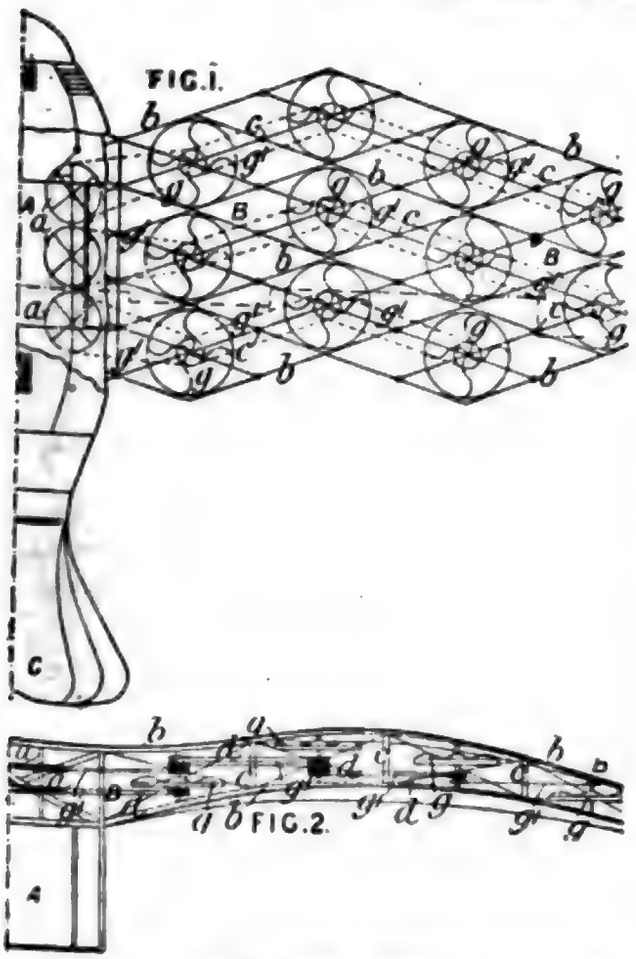
The motor A that drives the propeller is mounted on trunnions B about which it is turned by a toothed quadrant D, actuated by an electromotor H, the current to which is controlled by a baro-

Digitized by Google

meter, so that the altitude may be automatically regulated. For horizontal steering, the motor may be controlled by a magnetic compass and turned about a vertical axis. The current to the motor H is normally completed through the mercury in the short limb of the barometer, but as the pressure of the atmosphere increases the mercury breaks this current, and rising in the long limb completes another that excites a solenoid by which a reversing switch is operated.

12,469. June 6, 1896. **Flying Machines.** DAVIDSON, G. L. O., 85, Gracechurch Street, London.

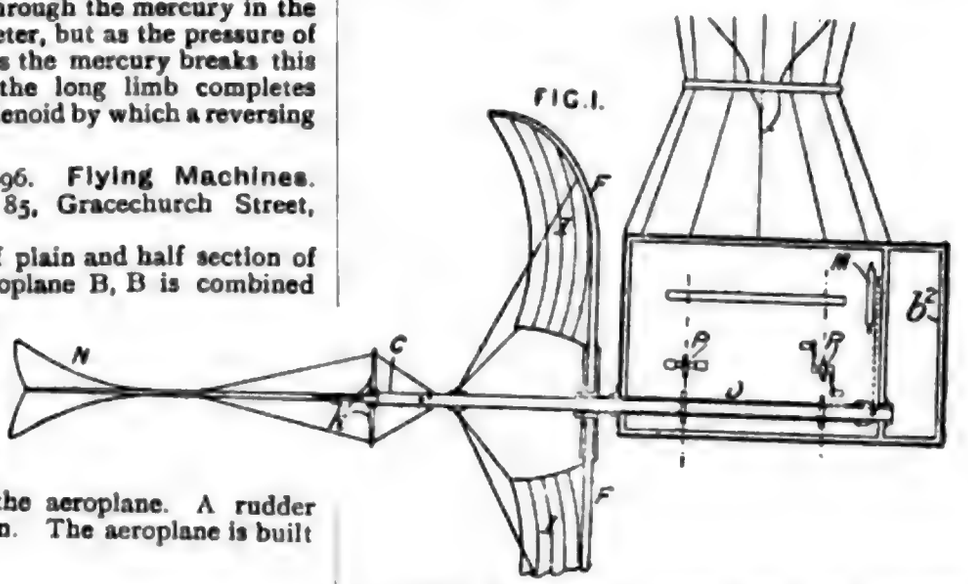
The Figures show half plain and half section of the machine. The aeroplane B, B is combined with a motor carried in the car A, and driving fans g, g through pulleys a, a and ropes g^1 g^1. The machine is lifted by the fans and moves horizontally by gliding downwards on the aeroplane. A rudder C is provided at the stern. The aeroplane is built



up of T steel b, braced together by verticals c and diagonals d. The surfaces of the aeroplane are covered with network, on which are hinged strips of celluloid or other material, which open as the machine rises and close as it descends.

14,139. June 26, 1896. **Aerial Machines.** JONES, J. and C. F., both of 5, Cyril Road, Small Heath, Birmingham.

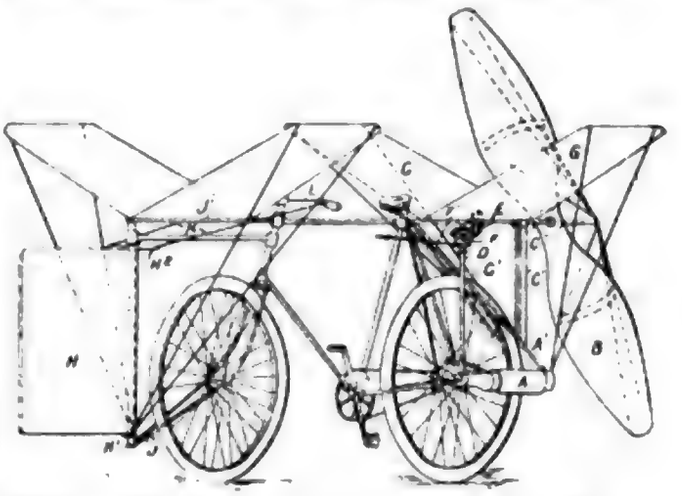
Aerial machines supported by aerostats are propelled by propellers F comprising radial arms projecting from a sleeve D and carrying sails I. The sleeve is rotated by pedals P in the car or by a motor carried in the space b^2. Steering is effected by a rudder N pivoted at k, and operated by yoke lines that pass through the hollow rod C,



on which the sleeve D works, and are controlled by a wheel M. The machine may be fitted with adjustable aeroplanes to vary the altitude.

17,119. August 1, 1896. **Aeronautical Machines.** E. J. PENNINGTON, Racine, Wisconsin, U.S.A.

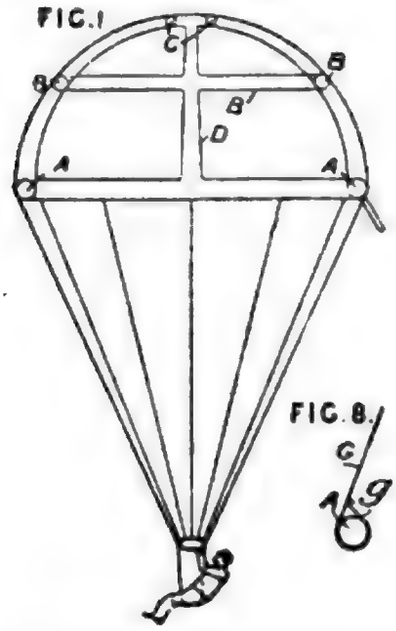
Aeronautical machine comprising a cycle similar to an ordinary road cycle, but driven by an engine applied to rotate a propeller, preferably at the rear end of the machine, in combination with an aeroplane or two or more aeroplanes for raising the machine from the ground, and a rudder for steering the machine. At the rear end of the machine is a propeller B carried by a shaft C which is supported by struts C^1, and is driven by a motor through a vertical shaft D and bevel wheels E. F is a clutch controlled by a handle F^1, by which the shaft C can be thrown in and out of gear when required. The propeller is suitably



stayed by wires B^1. G, G are aeroplanes carried by extensions of the bicycle frame, and suitably stayed by wires G^1. The aeroplanes are shown fixed, but they may be made adjustable, so that their angle of inclination may be changed when desired. H is the rudder for steering the machine; it is mounted to turn on a spindle H^1, which is carried at its lower end by extensions J of the front fork, and at its upper end by the extensions

J^1 of the bicycle frame. H^2 is a crosshead fixed to the rudder, and connected by side rods K to the steering handle L, which is loose on the front fork, and by means of which the position of the rudder is adjusted as required. When the cycle is rapidly propelled in a horizontal direction by the motor which drives the propeller the aeroplanes will operate to raise the machine and rider from the ground. The steering of the cycle is effected by turning the handle bar. In some instances a propeller or propellers in the aeroplane may be arranged to rotate about a vertical or nearly vertical axis to assist in raising the machine.

18,130. August 15, 1896. **Parachutes and Aerostats.** SLY, W. C., 21, Tressillian Crescent, Brockley, Kent.



One or more inflated flexible tubes A, B, C surround the parachute, and ensure its opening when it is released; it may also be provided with similar ribs D and radial arms. Fig. 8 shows the method of fixing the tube to the fabric G of the parachute by means of hooks *g* and eyes. The invention may be applied to the distension of aerostats.

United States Patents.

591,692. October 12. DANIEL REED, Eagle Lake, Minn. **Air Ship.**

A cigar-shaped, inflatable vessel, with car suspended therefrom by pivoted arms; a horizontal transverse shaft, with feathering paddles on the outer ends thereof; a longitudinal shaft at right angles to the counter shaft, with propeller on its outer end.

592,704. October 26. JACOB D. GRAYBILL, New Orleans. **Aerial Machine.**

Comprising a gas-holder, a car located within the framework of said gas-holder. Wings at sides, caused to move similarly to an oar in rowing, having a V-shape in cross-section.

596,231. December 28. JAMES RICHARDSON, New York. **Flying Machine.**

Elongated balloon, a fly-wheel mounted to rotate independently of other machinery, and a motor adapted to drive the same.

French Patents.

(Class VI., 3.)

267,689. June 9. KRAUSS. **Aerial Vehicle Simulating the Form of a Kite Able to Contain a Certain Number of Persons.**

267,801. June 12. RUEZ. **Dirigible Balloon.**

268,311. July 3. HOSDEN. **Dirigible Balloon.**

269,612. August 14. DELAURIER. **Steam Bird.**

250,436. (Certificate of Addition, June 4.) RIEDINGER. **Kite Balloon.**

German Patents.

(Class 77.)

95,178. December 31, 1895. E. J. PENNINGTON, Wisconsin, U.S.A. **Balloon or Aerial Vessel.**

95,914. September 25, 1896. CARL GÖTZKE, Berlin. **Airship with Concave Tail and Aeroplane.**

95,963. April 22, 1896. ALEX. SCHÖRKE, Dresden. **Steerable Aerial Machine without Rudder.**

PUBLISHED.

94,839. CARL EICHLER. **Captive Balloon.**

93,692. ARNIM BECKMANN, Charlottenberg. **Dirigible Balloon.**

93,184. HERMANN ISRAEL, Dresden. **Flying Machine with Perpendicular Acting Wings.**

93,387. T. H. HOMEISTER, Hamburg. **Captive Circular Flying Machine.**

Digitized by Google

0.5
45

PRICE, TO NON-MEMBERS, 2s.

UNIV. OF MICH.
AUG 4 191

THE AERONAUTICAL JOURNAL



No. 6. APRIL, 1898. VOL. II.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	29
THE POSSIBILITY OF SOARING IN HORIZONTAL WIND. L. HARGRAVE ..	29
KITES: THEIR THEORY AND PRACTICE. Capt. BADEN-POWELL	33
TWENTY-FOUR HOURS IN A BALLOON	45
NOTES: INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE HIGH ATMOSPHERE — FROM LONDON TO FRANCE BY BALLOON - THE PARIS EXPOSITION OF 1900—ARMY ESTIMATES, 1898-99—A NEW NAVIGABLE BALLOON—AN AEROPLANE PROPELLER—THE BLUE HILL METEOROLOGICAL KITE OBSERVATIONS—EDDY'S "HOUSE" KITES —SCIENTIFIC BALLOONING--BALLOON AND TRAMCAR COLLIDE— BALLOON NET OF SPIDERS' WEB	46
RECENT PUBLICATIONS	48
FOREIGN AERONAUTICAL PERIODICALS	48
NOTABLE ARTICLES	49
APPLICATIONS FOR PATENTS — PATENTS PUBLISHED — FOREIGN PATENTS..	49

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

From H. LACHAMBRE, Paris. ✤✤ *Established in England 12 years.*

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform Ladies and Gentlemen that from May to October, 1898, he will be making Bi-weekly Ascents at the Alexandra Palace, and intending Aerial Excursionists may obtain particulars of these Ascents by applying to

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCULLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

APRIL, 1898.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 8s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

ADVERTISING TERMS:—10/- Per Inch, Single Column.

NOTICE TO SUBSCRIBERS AND OTHERS.

It has been decided that the sphere of usefulness of this Journal will be greatly enlarged if the price be reduced. In future, therefore, the price will be **ONE SHILLING** per copy. Unless, however, the circulation increases in proportion, it will be impossible to maintain this Journal, at all events in its present form. All those interested in this subject are therefore earnestly requested to do all they can to increase the circulation of the Journal, and to send their subscription (four shillings) to the publishers, instead of relying on seeing the publication in a public library or other institution. Those who have already sent subscriptions for the year will be entitled to two more numbers of the Journal.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on Feb. 24th, when the following gentlemen were elected Members of the Society:—

Mr. W. F. REID, C.E.

Mr. B. F. BROOKE SEWELL.

Capt. L. S. BLACKDEN, West India Regt.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

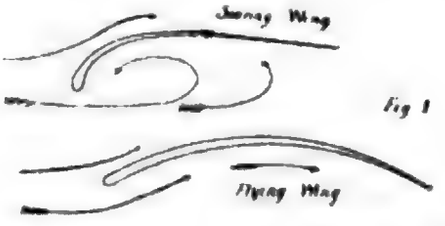
The Possibility of Soaring in Horizontal Wind.

(Paper read before the Royal Society of New South Wales by L. HARGRAVE.)

There is a publication called the "Aeronautical Annual," edited by James Means, Boston, Mass. In No. 2 and 3 of that work, Mr. Octave Chanute goes exhaustively into the question of sailing flight, and specifies every letter and article that bears on the subject. This paper may be said to take up the running where Mr. Chanute leaves off. My reasons for not writing to that periodical straight, are that publication would be delayed for many months; and the state of the art is such that at any moment some one of the many who are investigating this subject may drop on the facts stated in this paper, take out a master patent which would rule the construction of all future flying machines, and tax us all round for our good, as the protectionists say, thus throwing our work back for years. I therefore, with your permission, read this paper, and show the models that work as I describe, and thereby destroy the novelty of the invention for all time.

The point of doubt has been, how to account for the phenomenon of soaring in a horizontal wind. There is no difficulty in soaring if we assume an upward trend in the wind such as a cliff, building, or sloping hill will produce. But when we see birds soaring in light wind and storm, something beyond our knowledge is recognised as being at work.

Mr. Chanute shows the profile of a number of soaring and non-soaring bird's wings, and points out the downward projecting lobe at the front edge of the former, and also that there is a sharp curve just abaft the lobe on the under side. (Figure 1.)



A few experiments have been made at Stanwell Park to show how this affects the effective direction of the wind when soaring, with the

Digitized by Google

result, as I previously surmised, that it was found to create a vortex, and that the direction of the air current beneath the wing was that indicated by the arrows in Figure 1.

The apparatus used was a small bellows, a bent piece of sheet aluminium and a candle. The centre of the vortex was found to be approximately at the centre of the curve of the fore part of the aluminium sheet. (Figure 2). The candle, you observe, is not masked by the leading edge.



Fig 2

The quasi-wing was then bent like Figure 3, and the candle flame was blown in a



Fig 3

manner showing that in this case the vortex was elliptic. The pressure at A must be greater than at C or the candle flame would blow parallel to the blast. As a first attempt to show that the pressure at A was greater than at B, I cut a small hole at B and gummed a tissue paper valve opening towards B. I could not be certain that air was passing through it.

A portable forge was now arranged to deliver air through a two-inch horizontal tin tube, and various devices were used for hanging things in front of the blast. Among others an old and rough gull's wing showed the loose feathers blowing towards the front edge. (Figure 4.)



Fig 4

When a piece of the wing was cut off and hung at eleven inches from the blast with a negative angle of about 28 degs., it at once began to revolve in an elliptic orbit, the feathers on the under side of the wing being ruffled back at positions A and B (Figure 5). When attempting to repeat this ex-

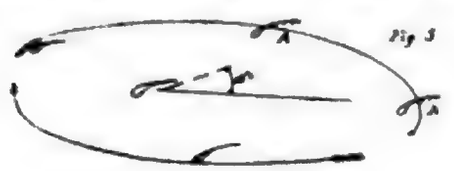


Fig 5

periment the wing could only be made to revolve in a contrary orbit to that shown in the figure. A piece of aluminium without a bulb would only swing very slightly in the line of blast.

A piece of tin folded with a bulb at the forward edge and some pieces of down gummed on the concave side, was set at a positive angle of about 6 degs., the down at the bulb blew strongly in the direction of the arrow (Fig. 6).



Fig 6

Thirty-two three-quarter inch square holes were cut in a curved piece of aluminium (Figure 7), and each hole was fitted with a



Fig 7

tissue paper valve lifting on the curved side. When the chord of the curve was at about zero, A and B sets of valves lifted tangential to the leading edge, and C and D sets of valves were fluttering with the blast.

A level sheet of glass with a little water on it was placed in the line of blast, and the curved tin (Figure 6) standing in the water with a sprinkling of red ochre, shows the vortex at a negative angle of about 30 degs. The tin was set at zero, but the after edge was slued round to 30 degs. by the rotation of the vortex.

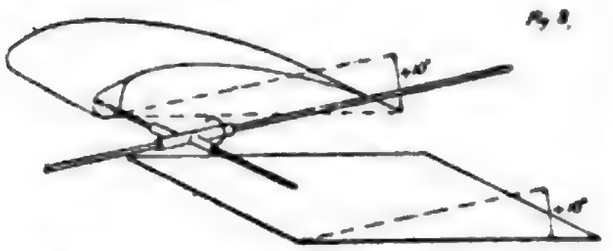
This is all very well as far as it goes, but something is wanted that would eliminate errors of direction of the wind, and some of the uncertainty as to the angles, and also to compare the curve with the plane surface. So I fixed a horizontal wire on a stand and pointed it towards the blast. A sleeve was on the wire revolving freely. On opposite sides of the sleeve I attached a bulb ended curved piece of aluminium and a piece approximately flat, with set screws to fix them at any angle with the direction of blast. There was a lead weight for balancing in the plane of rotation. There was nothing to stop the sleeve from slipping along the wire, which it did not do.

You will observe that with this apparatus if my personal equation gave any advantage to the curve it would be eliminated when the sleeve revolved 180 degs., and that both surfaces received a blast of equal intensity, and that placing the two surfaces on opposite sides of one axis is equivalent to weighing their respective lifting powers in a pair of scales.

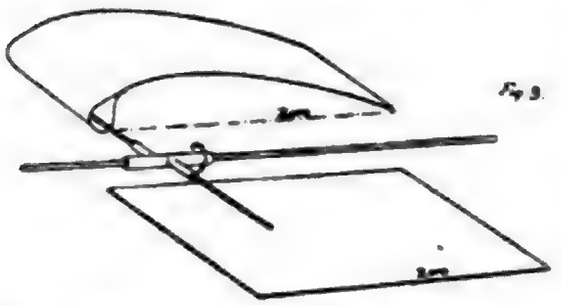
The plane and chord of the curve were first set at a slight positive angle (Figure 8). In this case the curve easily rotated the sleeve against the lift of the plane. There might possibly be no vortex under the curve,

Digitized by Google

and the stronger rotating force might be due to the greater angle of slope of the after part of the curve.

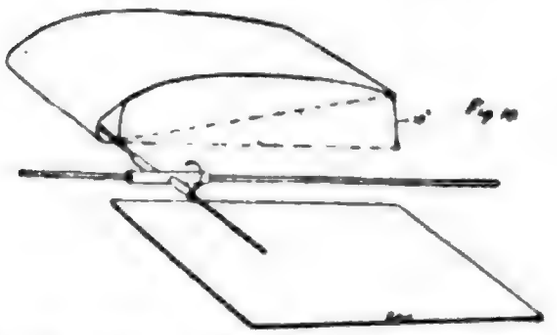


The plane and the chord of the curve were next set parallel to the line of blast (Figure 9). In this case the lifting force opposed

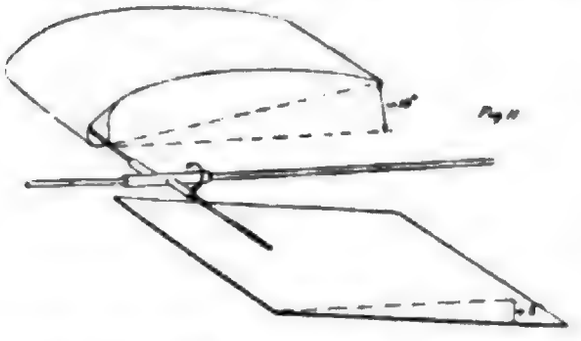


by the plane to the curve was nothing, although its resistance was that due to its area and the velocity of the blast, and the lift of the vortex under the curve easily overcame this.

In Figure 10 the plane was left parallel



to the blast, and the curve sloped at a negative angle; this angle was increased to at least 10 degs., and the lift of the curve still



rotated the sleeve against the resistance of the plane.

In Figure 11 the plane was put at a positive angle of 6 degs., that is, 16 degs. between the plane and the curve. The plane was now able to rotate the curve against the vortex. Figs. 12, 13, 14, 15, show the stream lines of the air when it meets a curve set at various angles.

To recapitulate, the experiments show—

1. That the profile of a soaring bird's wing and pieces of metal of a somewhat similar curve generate vortices on the concave surfaces when the chord of the curves makes a negative angle with the direction of the wind.

2. All the concave surfaces are in contact with air moving towards the mean direction of the wind.

3. That the mean pressure on the concave surface is higher than on the convex side.

4. That the chord of the curved metal may make a negative angle of 10 deg. with the direction of the wind, and still have a higher pressure on the concave side than on the convex.

And the direct inference is that gravity can be entirely counteracted by a volume of disturbed air moving in a horizontal direction; and that flying machines of great weight can be held suspended in a horizontal wind, and rise vertically without the expenditure of any contained motor force.

Having put matters so that anyone can easily repeat my experiments and elaborate them to the last degree of precision, we now see why the best soaring is done in steady winds. The answer is, the bird is less liable to lose its vortices by a sudden gust and have to take a flap or two to balance itself on a fresh pair. The difference between flying and soaring is that the air in contact with the underside of the wing is moving towards the bird's head when soaring and towards the tail when flying. A soaring bird's wing is a shield dividing two currents of air moving in contrary directions. The vortex draws towards the shield and pushes it into the low pressure above the wing.

There is a very similar experiment described at pages 79, 80, of this Society's (R.S. of N.S.W.) Journal for 1893, but I then failed to see the true cause of the phenomenon, and thought the air currents were those shown in the flying wing (Figure 1), whereas the currents were those of the soaring wing.

Mr. Chanute says that "Dr. Thomas Young, the great physicist, showed in 1800 that a curve S-like surface suspended horizontally by a thread advanced against an air jet impinging upon its upper surface." If this S-like surface proves to be like Figure 16, and he explains the cause to be the vortex shown

therein, it is only another proof that there is nothing new under the sun. The turn-up tail is now being experimented with, as I think

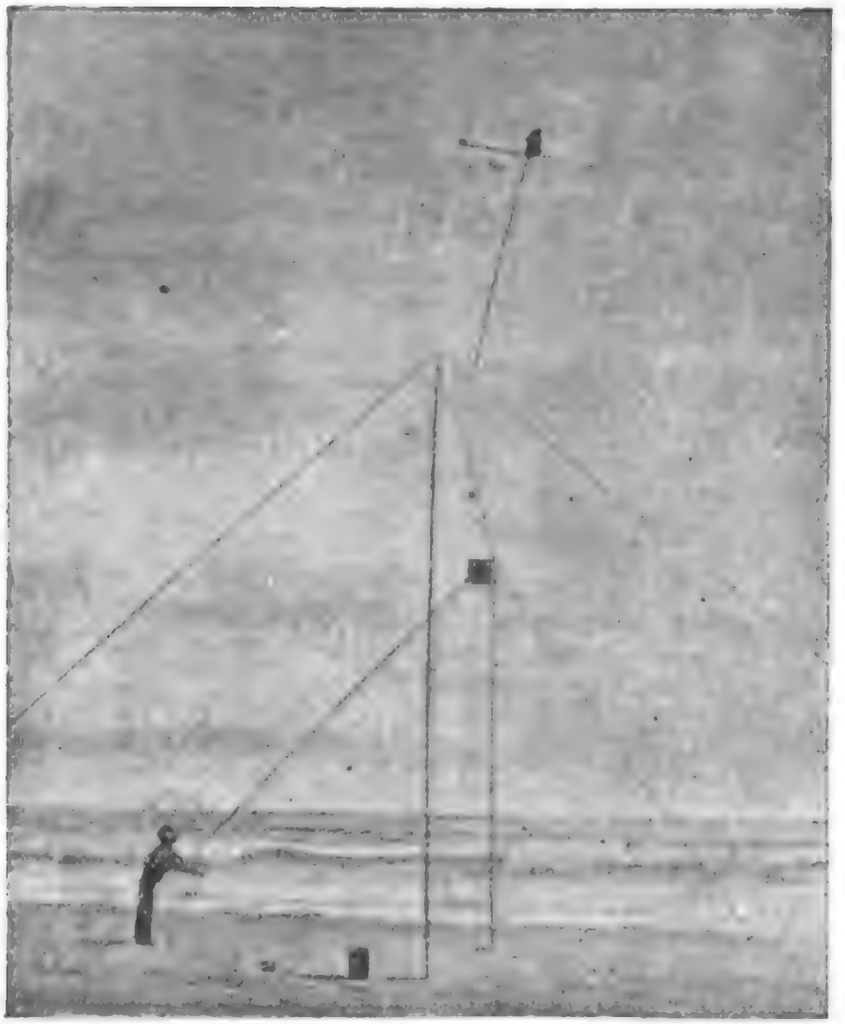


Fig 16

it provides automatic stability in a fore and aft direction.

Having experienced much of the monotonous process of repairing broken models, I have now devised and am using a method of experimenting that practically enables me to avoid all breakages. The apparatus used is well shown in the illustration which I think will advance the art of aerial navigation more than any amount of laboratory experiments. The two poles are twenty-four feet high and forty-eight feet apart. There is a cord between the tops of the poles, and the string of the soaring kite is tied to the middle of the cord at a sufficient height to prevent it striking the ground. I stand to leeward of the poles and start the soaring kite at a positive angle; it then flies as an ordinary kite to near the zenith. The vortex then forms under the curved aluminium surfaces and draws the apparatus at the full stretch of the string and cord, through the 180 degs. of arc to windward of the poles. The flag shows the wind to be horizontal, and the string that is plainly visible in the photograph shows the soaring kite pulling about 20 degs. to windward of the zenith. The wind was blowing at twelve or fourteen miles per hour, which was inadequate to effect the best pull the affair is capable of.

The projected area of the two curved surfaces is one hundred and eighty-nine square inches, and the weight is one pound four and a half ounces. The cylindrical aluminium tail is a serviceable construction. As yet I have been unable to make the kite stop when at or beyond the zenith, but the wind has been remarkably light for many weeks and few trials have taken place.



A very few trials will convince the most sceptical that if we are not soaring in moderate breezes before the end of the century it

will not be from ignorance of the way to do it.

It is obvious that soaring sails for marine propulsion have a vast future before them: and it is probable that craft so rigged will make better weather with a gale in their teeth than our best screw steamers.

Kites: Their Theory and Practice.*

(By Captain B. F. S. Baden-Powell, Scots Guards.)

The Kite, one of the oldest of inventions, familiar to everyone and to every nation under the sun, is nevertheless but little understood. It has always been the custom to look upon this contrivance as a toy and nothing else. Very seldom indeed, until the last few years, has it been put to any practical use. Yet it is full of promise, and those few who have made regular and careful experiments in this line have all been impressed with the satisfactory results obtained. A kite sailing in a wind gives a very considerable pull on its line, which pull can be converted into lifting power or tractive power. This appliance may then be used for lifting great weights, such as that of a man, high into the air, or it may be used for towing carts or boats. Kites can be made to ascend to very great heights, carrying up automatically registering meteorological instruments, or may carry a string to communicate with places a long distance off. Why then, it may be asked, are they not more often made use of? I believe the sole reason is that so few men have devoted any time to studying the theory of their actions, and that when the well-known rule-of-thumb patterns are departed from, innumerable difficulties crop up, and the apparatus, for some inexplicable reason, becomes frequently unsatisfactory, so that a cursory investigation of the subject only opens up a vista of obstacles apparently almost impossible to surmount.

But with a little practice and study the way becomes somewhat clearer, and, as we grope along, fresh discoveries are made which raise our hopes and show what great results we may possibly attain.

* A paper read at the Society of Arts on March 2nd, 1898, Prof. W. Grylls Adams, F.R.S., in the chair.

I.—PRACTICAL EXPERIENCES.

Having devoted a considerable time to researches in this line, and with a view of throwing some light on the intricacies and difficulties to be met with in kite-flying, I will briefly relate my own personal experiences in this subject. To begin with, I had one definite object in view. For some time I had been interested in and had practically worked with captive balloons for military purposes, and finding the behaviour of them so erratic in strong winds, to say nothing of the difficulties of construction and inflation with gas, and of the cumbrousness of the necessary apparatus, I was looking about for some other means by which a man might be lifted to a height above the ground. Kites naturally soon suggested themselves, and on investigation I found that trials had actually been made on several occasions to lift a man by this means, but that these had invariably proved failures.

In 1887, I made several trials with small cambric kites. The largest of them was 10 ft. high, and had two cross-pieces about 4 ft. wide. This only lifted a weight of 2 lbs., which was attached to the tail. Many varieties of kites were tried. Some were of the ordinary diamond pattern, some had a bowed top; one was circular. I even got a kite to fly which was absolutely frameless. However, I came to no very definite conclusions, my experiments were knocked off, and I had no opportunity of continuing them for five years.

In 1892, I made trials with a 20 sq. ft. kite, from which I obtained two most important results. The first was that I found it possible to do away with that appendage known as a "tail," which I had hitherto presumed to be indispensable, and the second result was that by attaching a bag to the string some distance from the kite, I found I could put weights into it until the kite was able to lift a weight of 6 lbs. or more in a fairly strong, though not exceptional, breeze. This result, the lifting of ·3 lbs. per square foot of kite surface, was most encouraging, and convinced me that, under such circumstances, I should be able to lift a man with a kite of 500 square feet. I, therefore, determined to go to a suitable place and carry out a regular series of experiments for a week or two. I thus learnt many lessons, one of the principal being to appreciate the fickleness and variability of the wind. A kite which flew perfectly one day would scarcely rise on another. It would be impossible to give anything like a detailed account of my numerous experiments. I tried a great variety in forms of kites and attachments of string. I have records of twenty-seven different days' experi-

ments in that year, and many of them were devoted to very small details of construction. These experiments were continued the next year, but it really seems extraordinary how little actual progress resulted, so often did one particular idea have to be tried again and again under all conditions, before any decided conclusion could be arrived at; and as often as not did I finally conclude that that whole series of experiments was absolutely negative. Yet, again and again I had such successful days of work that I was encouraged to continue. Here are some of the designs with

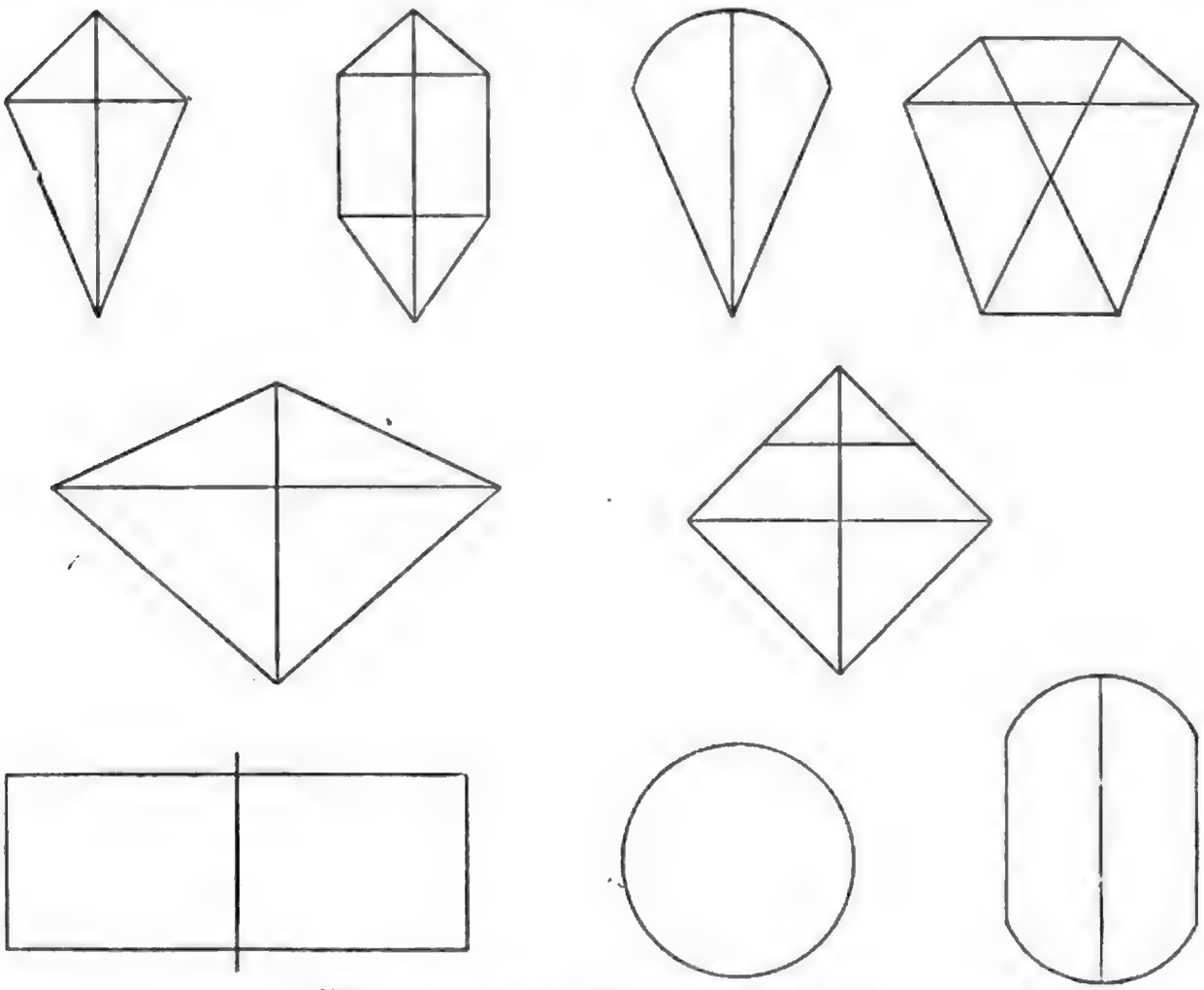


FIG. 1.—SHAPES OF EXPERIMENTAL KITES.

which, together with many others, I experimented (see Fig. 1). They all have certain advantageous qualities, but each required endless alterations before really satisfactory results were obtained.

These experiments have continued off and on up to the present, but, as I have said, it would be impossible for me to detail them all, though carefully recorded, I having up to date records of close upon 200 different days' experiments. I will therefore endeavour to summarise the results which I obtained.

I soon found that the wind force is always so variable from one moment to another that to record its velocity during experiments was hopeless, even though that may seem a necessity in careful scientific experimenting. I proved:—

1. That a tail is an unnecessary appendage to a properly constructed kite.

2. That by means of two strings suitably attached a kite can be guided so as to fly well some 45 degs. to each side of the wind course, and under favourable circumstances more.

3. That a kite which is perfectly flat, in very light weather will fly well, but that in strong winds it will be very unsteady.

4. That if it be given much of a "diedral" angle, that is, if the sides of the kite are thrown back like a butterfly's wings, or if it presents a convex surface to the wind it will not rise to so great an elevation as if flat, but will be steadier in strong winds.

5. That a large kite flies more steadily than a small one.

6. That if the vertical section of a kite presents a concave curve from top to bottom

(thus ⌒) the kite will ascend to a certain height and then "top," that is, dive over forwards till it lies horizontally on the air, and will then sink to the ground. But that if the form of the kite is such that its section presents two or more curves (thus ⌒) this tendency is prevented.

7. That the angle which the string takes with the horizon is variable, depending on the form of the kite and on the strength and direction of the wind (which sometimes has an upward trend). The most usual forms vary from 30 degs. to 50 degs.

8. That the weight which a kite can lift will of course depend very greatly on the wind force, but a concave form of kite is more powerful than a convex one. In a light wind about ·1 lb. per sq. ft. of kite may be counted on, in medium winds ·3 lb., in strong ·5 lb.

9. That if the weight to be lifted be affixed to the kite, or very close to it, it is very liable to upset the equilibrium of the kite and render it unsteady.

10. That "duplex" lines, that is two retaining lines fixed apart on the ground, and attached to two points, one on each side of the central axis of the kite, enable it to fly with great steadiness in all winds.

11. That in light winds the line may be attached higher up on the kite than in strong winds, and that this raising of the point of attachment causes the kite to rise easier, but to be more unsteady.

12. That a "regulator," or line attached to the lower part of a kite, the pulling of which alters the angle it presents to the wind, causes it to rise or fall as desired.

13. That the pull of the string of a kite may be taken roughly as—in light winds ·1 lb per sq. ft., in moderate ·7 lb., in strong up to 2 lb. per sq. ft. of kite surface.

As for shapes, there are many kinds which fly well if properly adjusted. The following points have to be considered:—

1. *Lightness*, so as to ascend easily in light winds. For some purposes it may be desirable to construct special kites, but these very light ones should never be used in strong winds, else they might become strained or damaged. 2. *Stability* in strong winds, which quality may also necessitate heavy construction, rendering the kite useless in light airs. 3. *Portability.*—For most purposes, especially when large kites are desirable, it is necessary that they should be easily folded up. 4. *Simplicity.*—The more complicated forms of kites are very liable to damage, and one little detail going wrong may upset the balance and the whole efficiency of the kite. 5. *Power* to lift or draw. Some forms of kite possessing these qualities may not have so much power as others. Thus a baggy concave kite is powerful, though perhaps unsteady. 6. *Good Pise*, that is to say power of attaining a steep angle with its string. 7. *Strength*, both to withstand the pressure of wind and to stand knocking about while on the ground.

Though not absolutely necessary, a vertical backbone down the centre of the kite seems desirable. The crosspieces to hold out the material transversely may be in front or behind the cover, but what is better still is to have them enclosed in seams in the material.

A difficult question to decide is that of flexibility or rigidity. If the framework of a kite be very flexible, it may in strong winds so bend when struck by a strong squall that it lessens the effective area, and thus automatically regulates the pull on the line. This characteristic would appear to be most desirable. I have arranged kites with springs, so as to fold back diedrally when struck by unduly strong puffs; but practically I must own that so far I have not succeeded in devising any very satisfactory arrangement. The same may be said as regards springs applied to the bridle so as to allow the kite to automaticaay present a different angle to the wind, according as it is strong or light. In practice a stiff, rigid kite is generally the most satisfactory, even though the pull on the line may in consequence be as variable as the changes of wind force.

What I have hitherto found to be the best form all round, is one nearly hexagonal in outline, stretched on a framework consisting of three poles of equal length, one forming an upright "backbone," the other two placed across it at right angles to form "crosspieces." This form of kite is very simple and portable, as, when the backbone is unshipped, the kite (with its bridle) can be rolled up on the crosspieces. When flying, all the central square forms a powerful concavity, or rather two concavities divided diedrally by the backbone to give steadiness, while the top triangle prevents all tendency to "top." This pattern, for distinction, I have designated "levitor." As regards size, I find the most convenient to be 12 feet high and 12 feet wide. This is about the largest size that can be handled easily. The poles are as long as can be conveniently transported in one piece. Such kites weigh complete from 5 lbs. to 7 lbs. according as they are intended for light winds or strong, and have an area of about 110 square feet. I have about fourteen such kites. My largest kite

Digitized by Google

was 36 feet high, containing 500 square feet, but this, though I flew it on some twenty different occasions, I found to be rather unwieldy. I have one 24 feet high which is more convenient. I am still not quite decided whether it is practically best to use one or two large kites, or a number of small ones, for lifting weights such as a man. Small kites are handier—they are lighter for a given area (since very large kites necessitate very large poles), and if one becomes damaged it is more easily replaced, and if an accident occurs to one kite while flying in mid-air, there is not necessarily a sudden collapse of the whole apparatus. On the other hand, big kites are simpler to make, and require but one adjustment. They seem to float more steadily in gusty winds (since they are acted on by a number of variable currents), there is less complication of strings, and they are probably more efficient. I have frequently tried an appendage like the rudder of a ship, which has a decidedly steadying effect.

There is one form of kite which calls for special comment. It is known as the "Hargrave" or "box" kite, having been invented by Mr. Hargrave in Australia. I have here a specimen which will more readily convey an idea of its peculiar construction than a long description. You see it is like two boxes with their lids and bottoms knocked out and connected a short distance apart. This kind of kite has found great favour in America, where it has been used for many purposes, including the high ascents for meteorological purposes at the Blue Hill Observatory.

My own experience with such kites is rather limited, but in practice I have found them possess very little advantage over other good forms, and I am unable to comprehend any very special theoretical advantage in them.

Such a form of kite is bound to be heavy, and I will endeavour to show later on the theoretical objections to a heavy kite. The average weight of those used at the Blue Hill Observatory is about ·1 lb. per sq. ft. of sustaining surface. My "levitor" kites (which are of much larger size, and should therefore be heavier in proportion) averaging ·05 lb. per sq. ft. That is just half the weight for a given area. It is almost bound to be more complicated and difficult to fold up. Being heavier, I have always found a Hargrave more difficult to get up in light winds. In very strong winds, though the Hargrave may perhaps be steadier than any other single line kite, there is no comparing it for steadiness with one on a system of duplex lines. Still, for certain purposes, such as attaining great elevations in strong winds, it may be useful.

As regards retaining lines, I have generally used one of three systems: (1) the usual single line; (2) the "duplex," with the two lines fixed apart so that they join the kite at an angle of about 60 degs.; and (3) the "rein" or steering lines (for small kites), in which the duplex lines are held together in the hand, and used like reins for steering the kite.

The first system is employed if it is desirable to get out a great length of line, or for towing, and when steadiness is not a matter of importance; the second, when great steadiness is desired; and the third for steering kites.

In using several kites together, there are several different methods of attaching them, best explained by diagrams.

a. The "duplex" applied to several kites (difficult to apply more than two or three kite

b. "Parallel" system, each kite presenting the same angle as the one below it, and thus the whole system is under control.

c. Single line passing through the kites.

d. Single lines, each lower kite having a "back bridle."

e. Independent kites "buoying" the line.

Each of these systems is applicable under certain circumstances, and a combination of one or more is often used.

I have here a specimen of a kite fully fitted. By this system of running thimbles it can be used so as to fly independently on a single line, or duplex on two lines.

I also have a model to show what I believe is the best method of suspending the car to lift the man. In this he is perfectly steady. It cannot swing or rotate.

As regards materials, I have found that for the framework of all kites there is nothing like bamboo, though this material may be obtained in many different varieties, some not so suitable as others. I have tried various sorts of wood, but have always been dissatisfied with it. It is generally either too heavy or too brittle. Male bamboo, though very strong, is too heavy or too flexible. The same in an increased degree may be said of steel tubing. The thinnest steel I could obtain is very much heavier than bamboo of somewhat the same diameter, even though it may be stronger. If of much less diameter it does not possess the requisite rigidity. It is of course also much more expensive.

The cover I have usually made of light cambric, which is very satisfactory, seldom tearing unless through catching in some tree, etc. For very light kites I have tried silk, and also goldbeaters' skin. Paper is a wretched material, even for the roughest models. It is so liable to get torn even before an experiment can be completed with it.

Digitized by Google

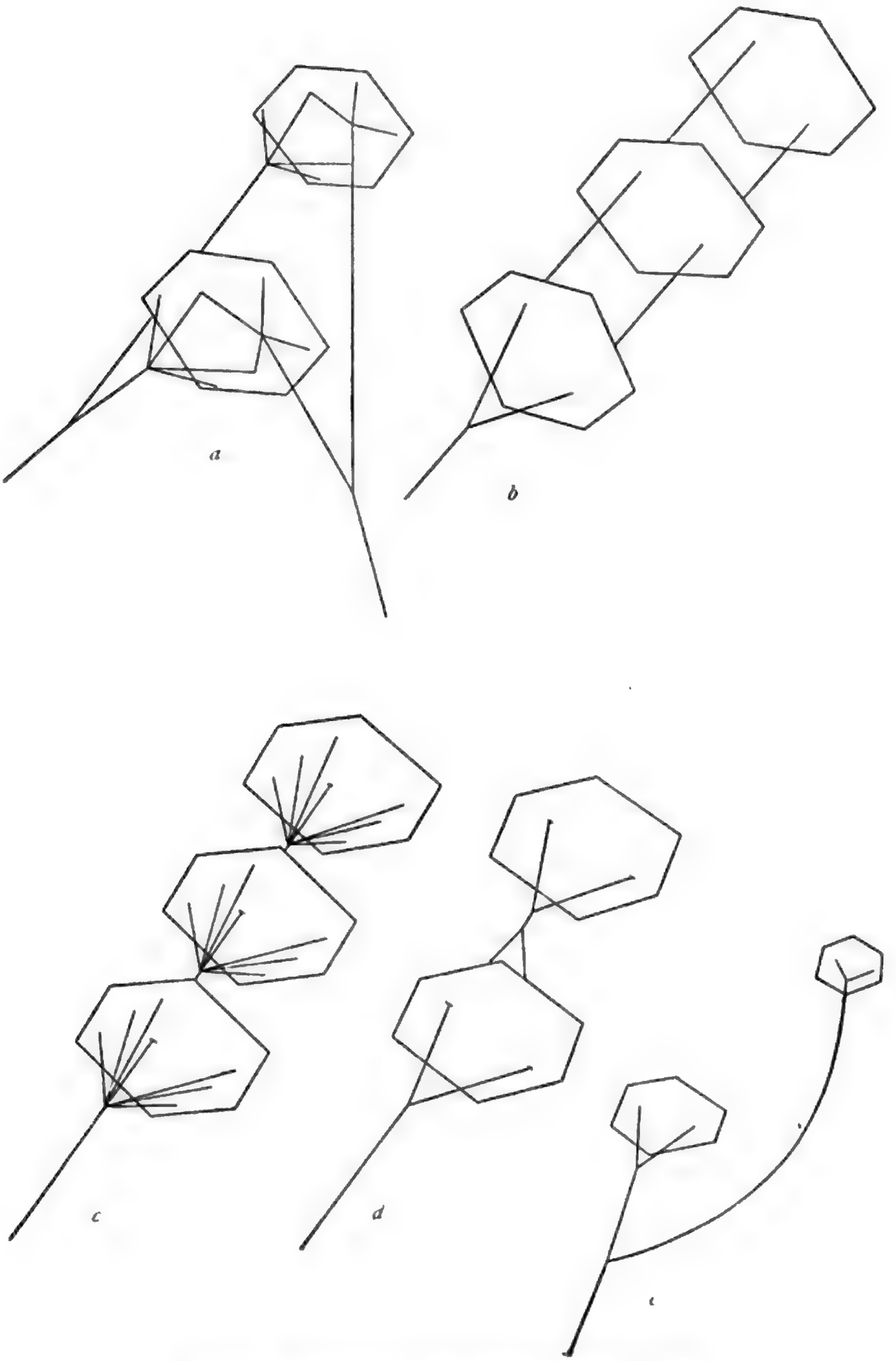


FIG. 2.—METHODS OF CONNECTING SEVERAL KITES.

Digitized by Google

For cordage I have generally used Italian or Russian hemp. Steel wire ought to possess great advantages; but in practice—at all events for experimental work—its liability to kink, to get rusty, to attract lightning, and its awkwardness to handle, render hemp preferable.

Let me add a word against all metal clip-hooks, spring swivels, etc., which I at first used much, but soon found to be unreliable, heavy, and generally unsatisfactory. Wooden toggles and eye-splices are much to be preferred.

I might emphasize the fact that these remarks on the materials used in kite construction are derived from my own experience. Careful experimenters in America have come to other conclusions. (Vide Marvin, Millet, Lamson, etc.)

I will now say a few words as regards the practical working of kites.

In very light winds there may be a difficulty in getting a kite up. Then it is best to lay out a long single line along the ground, say 200 or 300 yards long, let one end be attached to the kite, and a man hold the other end and run with it. The kite will thus rise up into the air some 300 or 400 feet, even though it be a dead calm. But often there is a light breeze above which is imperceptible below, and if the kite floats of itself its string may be affixed to a second kite, which it will gradually draw up, and thus a whole series carried up to the upper current.

Even very large kites may be got up in this way. I have several times tried towing such kites with about a dozen men running, or by attaching the kite line to a waggon drawn by horses. By both these methods a man has been lifted up.

The subject of the upper currents of the air has been discussed by Mr. Douglas Archibald, who conducted a series of kite experiments which tend to prove that the velocity always increases with altitude, and in the proportion of

$$\frac{V}{v} = \sqrt[4]{\frac{H}{h}}$$

when V and v represent the velocities, and H h the corresponding heights.

In strong winds it is usually best to use duplex lines, the ground end fixed to pegs or to trees, etc., so that the wind blows up between them. In strong winds the retaining line or lines should always be securely fixed before the kites are let up, else it may be impossible to hold them.

As far as practical utility goes, I have used kites for the following purposes:—

1. To lift a man similarly to a captive balloon, which may be very useful in military operations as well as for all purposes where a lofty look-out may be desirable. I have actually been lifted up on about eighteen different occasions, sometimes going as high as 100 feet (the limit of the perpendicular rope). I have also let up weights, equal to that of a man, 300 feet high; and I believe that the height attainable is chiefly dependent on the length of rope available. The kite area has varied from 300 to 800 square feet. In most cases I have used from three to eight kites, but have also made ascents with one kite of 500 square feet.

2. To lift a torpedo or large charge of explosive to be wafted over a fortification, etc., I have let up some hundreds of pounds weight and sent it off over a place half-a-mile off.

3. To take up a photographic camera so arranged as to obtain a photograph of the country beneath. I have here some specimens taken.

4. To sail boats, for which purpose kites seem most suitable as the boat can sail very close to the wind, and with no fear of capsizing.

5. To draw a cart, which may be very useful in open country. It is surprising the amount of power the kites possess even in a light wind.

6. Communication between ships at sea, by which letters and parcels can be conveyed without the necessity of lowering a boat.

Also for signalling, getting ropes to otherwise inacessible places, and many other purposes.

II.—THEORETICAL PRINCIPLES.

The theoretical principles of kite flying seems to have received but little attention from scientists. Professor C. F. Marvin, of Washington, has recently published two monographs, "Kite Experiments at the Weather Bureau," and "The Mechanics and Equilibrium of Kites," which practically constitute the entire literature (in English) on the subject, except for a few remarks in Mr. Chanute's interesting work, "Progress in Flying Machines," and in the "Aeronautical Annual, 1896," while the scientific researches of Professor S. P. Langley ("Aerodynamics") also throw great light on the subject.

In order to investigate the results of the forces acting on a kite we will assume that it is a flat plane, and that the wind blows in a steady, horizontal course. These conditions are practically but seldom met with, the kite surface usually forming a variety of curves and planes at various angles, while the wind is always variable both in force and direction.

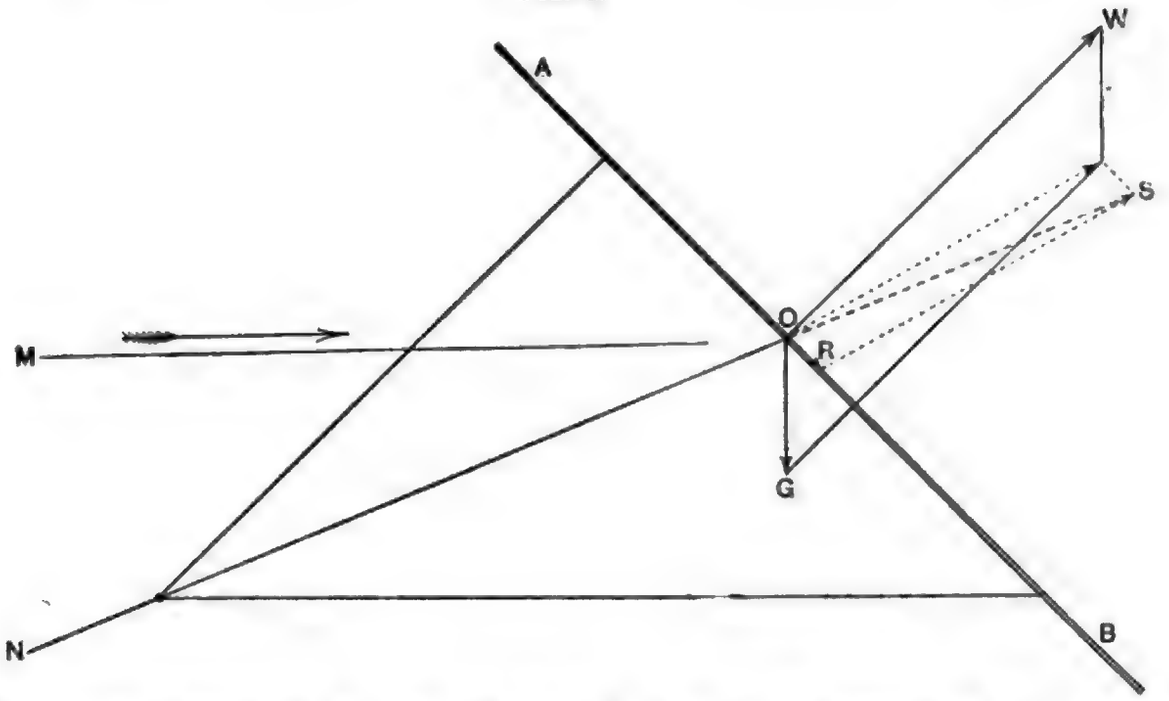
There are two forces acting on the kite in opposition to the retaining line—viz., the wind,

Digitized by Google

and the weight of the kite. The wind acts in several ways; it presses on the whole under-surface normally to the general plane of the kite; it acts on the front edges and on any projection tending to drive the kite in the direction of its central vertical axis; and it acts on the retaining line. There may also be a certain amount of "skin friction," though this is probably a very unimportant factor.*

In Fig. 3 let A B represent a vertical section of the kite; O W the wind pressure, which will be at right angles to the plane of the kite;

FIG. 3.



O G represents gravity, or the weight of the apparatus; O R the "frontal pressure," that is, the edge resistance of the kite and cords and all projections to the wind. Then, by completing the parallelogram, we get O S for the total resultant, which gives the force and direction which the string has to oppose in order that the kite shall remain in equilibrium.

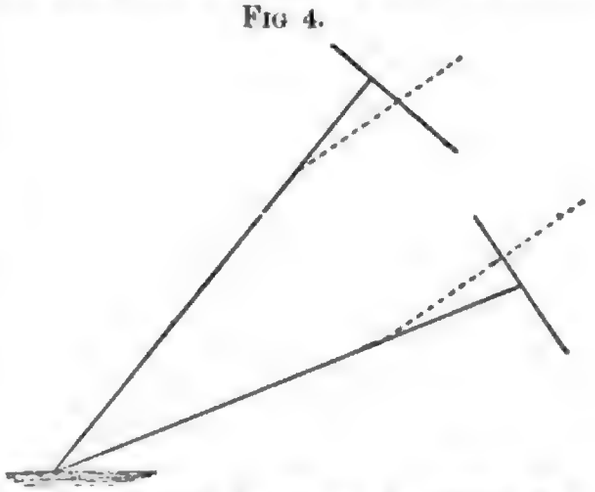
From this figure it will readily be apparent how important are the proportionate relations of weight and frontal pressure to the effective wind force, in that, as the latter (O W) increases, the total resultant, or direction of pull, becomes more and more perpendicular to the kite. Hence, with a heavy kite in a very light wind, the string will pull at such an angle that the kite cannot rise to any great height.

As the kite rises in the air, pivoted about the base of the string, the direction of the wind force remains the same—that is, normal to the surface—but it lessens in intensity as the angle presented by the kite becomes smaller, while, on the other hand, the force of gravity or weight remains the same in intensity, but becomes more perpendicular. The frontal pressure, as a rule, increases slightly. Therefore, as the kite approaches the zenith, the total resultant becomes more at right angles. (Fig. 4.)

On starting the kite, the string will naturally be nearly horizontal, as M O. The direction of pull being O S, the kite will rise upward, until the string comes in the position, O N. If it rises above this, it will, of course, be blown back to the position O N.

Hitherto we have taken the point O as the centre of effort of the wind. But in practice this exact point is not easy to find. Moreover,

FIG. 4.



as will presently be shown, it shifts about accordingly to the angle of the plane. To overcome this practical difficulty a "bridle" is used. This consists of strings fixed on the

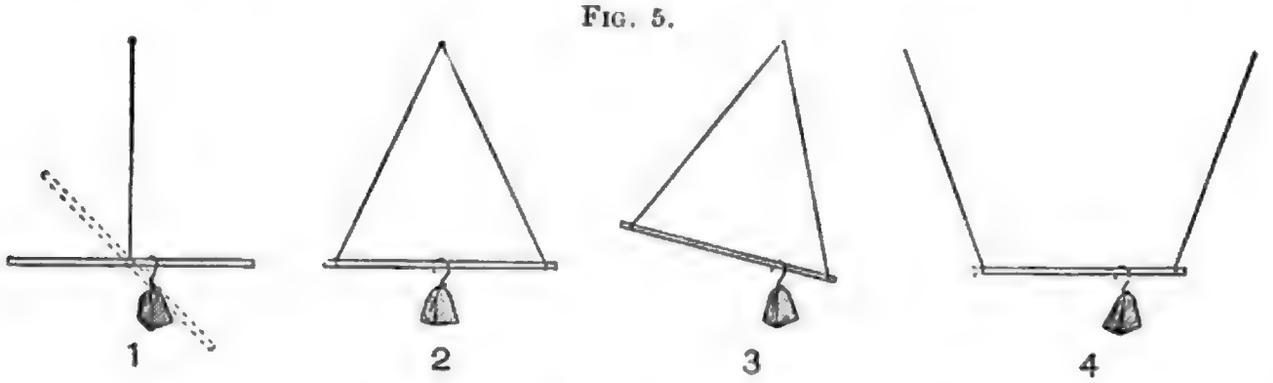
* "The friction of the air is inappreciable. This fact may be stated as the result of my own experiments, and of well-known experiments of others."—Prof. Langley's "Aerodynamics."

Digitized by Google

kite at points above and below the place of the centre of effort, and connected together in the ground line. The use of the bridle, then, is to automatically adjust the direction to the pull of the string towards the centre of effort.

The action of this contrivance can be more easily understood if we suspend a rod horizontally by a piece of string fixed to its centre. If a weight be hooked on to the rod on one side of its centre, it at once tips up. The same occurs with a kite in which the string is affixed to one point—directly the wind force is greater on one side than the other the kite must tip up. But now if we put a bridle on the rod, i.e., suspend it by two strings fixed apart on the stick, and held together above it, a weight can be hooked on to any point between the strings without the rod tipping up to any great extent. Under such circumstances the rod will be inclined until the weight (or rather the centre of gravity of the whole) hangs just below the point of suspension. In the kite this means that such an angle will be presented to the wind that the pull of the string will point towards the centre of pressure.

FIG. 5.



With a plane surface placed at right angles to a current of wind, the centre of the figure will be the centre of effort, and it would be comparatively easy thus to determine the exact centre of effort of any given kite were it not for a law of nature only recently determined, which is, that as a plane presents a less angle to a fluid impinging upon its surface, the centre of pressure moves forward towards the front edge of that plane. Therefore, as a kite rises in the air the angle it presents to the wind becomes less, and therefore the centre of pressure shifts forward.

The experiments of Langley, Joessel, and Kummer practically agree in showing that the centre of effort works forward of the centre of area according to the formula—

$$d = (0{\cdot}9 - 0{\cdot}8 \sin \alpha) L.$$

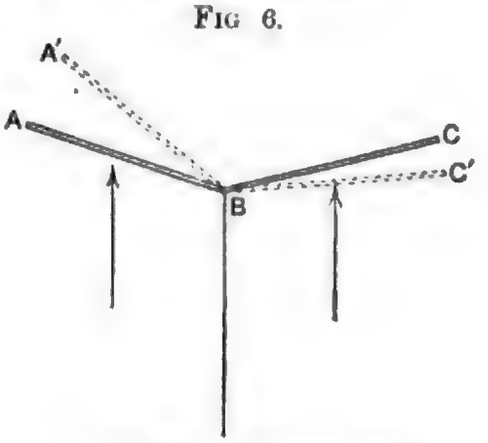
L being the length of a square plane, which may, of course, give a slightly different result to the ordinary shape of a kite.

I have already referred to the "diedral" angle of a kite giving stability. The reason for this is easily demonstrated.

A B C (Fig. 6) represents a horizontal section of a kite having a considerable diedral angle. The arrows show the direction of the wind force against the two sides. Now, in strong winds many twirls and eddies are found in the wind currents, just as one sees them in a rapid-flowing river. Such eddies cause uneven pressures to be produced on different parts of a kite. If then a greater pressure is suddenly brought to bear on the side A B, this side is driven back, and a smaller angle is presented to the wind; while the other side, B C, is pressed forward, and, by becoming more at right angles to the direction of the wind, takes a greater pressure, and thus equilibrium is automatically restored.

It has been pointed out that this form of kite has less tendency to rise high; the reason of this, too, is explicable. The bending back of the sides, of course, diminishes the effective area of the kite—that is, wind-pressure is diminished; but the weight and frontal-pressure remain the same. Hence the resultant pressure acts less perpendicularly.

FIG 6.



CURVED SURFACES.

We began by assuming that the kite was a flat plane, which it seldom is in practice. The

action, however, of a current of air impinging on a curved surface is one very little understood. I think we can explain the action of a kite whose whole vertical section consists of one concave curve, and which, as I have said, in practice is always inclined to "top" over into the wind. On the principles already explained, we can understand how the pressures towards the upper portion of the curve, where the surface presents a small angle to the wind, are advanced forward, and that the result will be a strong upward pressure. When the kite has risen to a given height, the angle presented by the front portion of the curve will have become less and less, owing to the direction of the pull of the string, until it is absolutely horizontal, and then not only is there no pressure on the front part of the kite, but the wind will pass over the top, and cause the flexible material to shiver and bag, so that all buoyancy is lost, and it then naturally rolls over and spills out its wind.

DUPLEX LINES.

The theoretical advantages of "duplex" lines can be explained in the same manner as those of the bridle. If a horizontal section of the kite be taken it will be like the rod suspended by a string from the centre. If the wind pressure comes on one side the stick or crosspiece of the kite is tilted over. This will at once cause the whole kite to be driven away to one side, and thus in a variable wind the kite will be continually moving from side to side. Directly, however, we suspend the rod by two strings it is apparent that no shifting of the weight or pressure can cause it to move (see Fig. 5, No. 4).

TAIL.

It may be as well to inquire into the *raison d'etre* of the tail. It is not likely to have been applied to kites all these years without some reason. Now we know that a badly-constructed kite is liable to turn over and dive to the ground, or swing from side to side. How can this be prevented? If the lower end can be kept down and back the kite cannot capsize. If a heavy weight were attached to the bottom of the kite any irregular movement would set it swinging like a pendulum, and this action would probably be increased until the kite revolved right round. Moreover, the weight would simply tend to pull the kite straight downwards towards the ground. On the other hand if a long light tail were attached, so as to be driven back by the wind, it would have a tendency to pull the kite flat. By contriving the two, judiciously adding weight to a long tail, the desired result may be obtained of rectifying the faults of a badly-constructed kite.

It is often difficult to get practice to agree with theory. Thus, for instance, according to theory, if the wind is blowing at about 50 miles an hour, the pressure on a plane surface at right angles to it should be at the rate of 12 lbs. per square foot. Thus on 100 square feet it should be 1,200 lbs. But if the angle be inclined, even to 30 degs. with the horizon, the normal should be .8 of this, that is, 960 lbs. Practically, however, though I have had out kites to test their pull during strong gales, I have no record of a 100 ft. kite ever pulling more than 250 lbs. on the string, and this amount is quite exceptional.

When considering what weight can be lifted by a kite, and to what height it can be raised, the forces acting on the string must be considered. These forces are the weight of the line and the pressure of the wind upon it. These cause the line to hang in a curve, more horizontal near the ground and more perpendicular near the kite. The total force thus acting tangent to the string (commonly called the "pull") may be divided into two forces of "lift" and "drift," that is, a force acting vertically upward and one acting horizontally in the direction of the wind. Now it can readily be understood that the "lift" is greater in proportion near the kite than near the ground, while the "drift" may become so great near the ground as to pull the line horizontally, and not even lift it off the ground. But on comparatively short lines and in a good wind this curve is not of importance. We have, however, to consider the effect of hanging a heavy weight on the line. That portion above the weight will remain at the angle caused by the pull of the kite. But the angle of the string below can be readily found.

DISCUSSION.

The Chairman said the experiments of Captain Powell established a good many facts which had an important bearing on this interesting subject, and the explanations he had given were very clear. He had had the privilege of seeing and taking part in some of the experiments carried out last week at Hounslow, and seeing how the kites actually performed. As was shown in one of the slides, the kites were sometimes rather unsteady, and swayed about; the fact was that the wind was very variable indeed, and although at the surface of the ground it might seem to be steady, yet when tested by these kites a little way up, it did not remain steady many minutes together. Some of the principles which had been estab-

lished by Captain Powell, as, for instance, the application of two strings to keep the kite steady and guide it, and make it fly even at an angle to the wind, were very important in practice. A kite which would only fly in the direction of the wind would be of comparatively little service, because it seldom happened that the wind blew exactly in the required direction. He was hardly prepared to find that so much had been already accomplished, and was very glad that the subject of aeronautics had advanced so far within the last three or four years. Kites would be useful, not only for military purposes but also to travellers, and he had no doubt that if Nansen had had kites which were easy of manipulation he would have been able much more readily to overcome some of the difficulties he met with in his Arctic expedition. In connection with sledging he should think they would be of great use, and would be available where balloons were out of the question. An international conference on the subject of aeronautics was shortly to be held at Strassburg, when the use of balloons and kites would be discussed, chiefly in connection with meteorology, with the view of selecting a number of stations where observations might be made simultaneously on the physical phenomena of the atmosphere over a large area.

Mr. R. H. Scott, F.R.S., said a special committee had been appointed at the Meteorological Conference in Paris in 1896 to study the question of simultaneous balloon ascents for the purpose of making observations, some carrying human observers, and others only instruments, and, on three occasions, balloons had been started at the same time from Paris, Strassburg, Berlin, Munich, and in one or two cases from St. Petersburg, in order as it were to take soundings of the atmosphere on the same day at different points. He had received notice of a meeting of this committee, which was to be held at the end of the month, from Dr. Hergesell, the head of the Meteorological Institute at Strassburg, chairman of the committee, and also signed by the well-known name of Monsieur de Fonvielle. He saw that one particular section of the programme was devoted to the use of kites, for which Mr. Rotch was going to furnish an account of his experiences at Blue Hill. The committee would deal particularly with a form of apparatus, the kite-balloon, of which he believed the inventor was present. He understood that an ascent was to be made with one of these kite-balloons during the conference. He should be glad to receive papers from any one who had anything to communicate to the conference, and, if sufficient notice were given him, to procure invitations. They were much indebted to Captain Baden-Powell for the trouble he had taken in preparing the paper.

Mr. Douglas Archibald said he had been much interested in hearing the experience of Captain Powell, which seemed to bear out practically results which Professor Marvin had deduced theoretically, as stated in his recent work, and he must say that in these matters he preferred the deductive to the inductive method. He considered Professor Marvin's work on kites was perhaps the best handbook on the subject, and he had done good service in working out the theory so fully. Captain Powell had dealt more with the kites themselves than their applications, on which subject he thought there was room for another paper. There was an immense field open in that direction, for this was a science which had been too long neglected. Until he first resuscitated kite flying in 1883 it had been buried in oblivion since 1847. He had recently tried to interest the War Office, but was told that the military authorities did not think it necessary to experiment any further. He was sorry to hear that, because he thought if the experiments had been carried a little further, in all probability some very practical results would have been attained. In the recent Tirah campaign a few kites with cameras attached to them, would have been of very great use, and might have given information as to what was going on at the other side of some of those very steep and inaccessible hills He had lately been thinking out one or two forms of apparatus by which this could be accomplished, and was confident that it would be quite possible. Some people might have doubts about it, but, at any rate, there could be no harm in trying. The Hargrave kite exhibited was not quite as it was described by the inventor. He met Mr. Hargrave in Australia, and spent an afternoon with him in flying his kite. The front and back were fastened together with wires or bamboos, and there were also cross struts, so that the whole thing was rigid. It was probable that Captain Powell's kites were lighter, but he thought some form of the Hargrave was the most satisfactory, especially in a heavy breeze, but he had not seen Captain Powell's in action, and could not therefore judge of their relative merits. He agreed that bamboo was by far the best material to use. People often said, how could you get up a kite when there was no wind? but that was a pure assumption; we were at the bottom of an aerial ocean, and very few knew what was going on above. Some years ago—in 1883, 1884, and 1885—he made a great many experiments, and

Digitized by Google

he remembered that frequently his kites were up in the air pulling tremendously when he could have lit a match without the slightest flickering where he was standing. That usually occurred at night, and it had been shown by Professor Marvin and others that night was the best time for flying kites, though it might not be the most convenient. During the day the air was more disturbed. There was a question of the apparent discrepancy between observation and theory with regard to the pressure and lifting power which ought to be cleared up. He believed it arose in great measure from continuing to use an old formula, which had been shown to be erroneous, the co-efficient being really ·0026 instead of ·005. The whole subject was one which required working at rather than talking about, and he should like to see more people paying attention to it, and applying it in various ways. It was already used for photography, and he had heard recently from naval officers that it would be very useful for communication between ships at sea. For scientific purposes generally, it would no doubt come into use for ascertaining pressures and temperatures at great heights. In America he saw they were planning a series of kites at high levels, so as to form isobaric charts at an elevation of 5,000 feet, which seemed rather a bold idea. When he was at Blue Hill, on one occasion he superintended the kite flying, when they elevated a barograph to a height of 7,300 feet, and after he left they reached as high as 9,000 feet. When they could carry recording instruments to heights like that, it seemed to him they were running balloons rather hard. Captain Powell said he was not certain whether it was more advantageous to use large kites, or small, and he agreed that it was a matter on which you had to compromise. A large kite was more useful and convenient, but small ones were more portable. Mr. Hargrave once said that he thought a man with five of his kites under his arm could ascend from the top of an omnibus. It would be rather an uncomfortable place to start from, probably; but his idea was to show the degree of portability possible. He was rather in favour of large kites himself, as they flew better; but, if for other reasons it was desirable to have several smaller ones, it was best to have, say, three at the top and one or two below. It had been shown by theory, and he believed it would be found true in practice, that the best arrangement for kites tandem was to have a bunch at the top, and then the others seriatim below. The greatest pull was obtained where you got the greatest velocity, and the total lifting power was greater with such an arrangement. Since he invented the kite-balloon some years ago he had not touched the subject at all, but when in Germany last year, he heard that a kite-balloon of some form had been adopted by someone, and hoped it would prove successful. He could not help thinking that the idea had something in it. A balloon rose in a calm, and a kite rose in a wind, and when you had something between a wind and a calm, a combination of the two seemed to be the right thing. When the wind dropped, the balloon kept the kite up, and when the wind rose the kite had a tendency to keep the balloon up. His plan was to have a balloon with a kite fastened in front of it in such a way that the kite shielded the balloon from the effect of the wind. In fact, the late Mr. Charles Spencer once told him that he thought of it as a balloon shield. The balloon must not rise much above the kite, otherwise the wind, being horizontal, would have a tendency to pull the balloon away from the kite, so that the balloon must be rather smaller in section. The fastening was effected by means of straps from the top of the balloon. It was described and figured in *Nature* in 1884.

Colonel Allan Cunningham said it was rather curious that the toys of a thousand years ago should be now utilised for military purposes, but it was not quite correct to say that kites were only now being used for the purpose of traction, because he had read of their being used to draw carriages and boats long ago. The modern use of the war balloon also, he believed, proceeded from a toy. The combination of the two was very interesting, because the captive balloon was at its best in calm weather, and it was very difficult, and indeed dangerous, to use in a high wind, whereas a kite was difficult to use in a light wind, and was at its best in a strong wind. In these kites they saw a very pretty adaptation of means to ends—the shape of the kite, the shape and the disposition of the frame, and the combination of cords. One of the greatest advances seemed to be in the adoption of a number of cords, which secured that great desideratum, steadiness. He had seen them flying, and those which were high up were very steady, and even those low down, probably in consequence of these attachments, were fairly steady also. On the other hand, the number of cords introduced certain practical difficulties, each point of attachment being a source of weakness, and on each occasion when he had seen a public exhibition something gave way, either a cord or its attachment, and the kite got out of its proper position. If there was a man up in a car this might be dangerous. The exhibition to which he referred was at Ipswich,

and there was a very large crowd present, which probably was not favourable to success The kite-balloon was also very interesting, but he must confess it was rather ugly to look at, and a balloon being such a delicate object, he always had a fear that it might be injured if anything gave way in the framework of the kite.

Mr. W. F. Reid said he happened to be present at Ipswich when the kites went up, and though there was a little hitch at the beginning, he thought it was due to the pressure of the crowd, which led to the rope being pulled at the wrong moment. The defect was soon remedied, however, and they went up all right. He had the pleasure of going up about 100 feet in the basket. He thought the portability of the apparatus had hardly been sufficiently dwelt upon. On the occasion in question, he saw the whole thing being taken into the park on a costermonger's barrow. This was a matter of great importance for military purposes, and he agreed with Mr. Archibald in thinking it was a great pity that some of these kites were not available in the war on the Indian frontier. One mule would have been quite sufficient to carry everything necessary to enable our brave soldiers to see what the enemy was doing. The system of double lines which gave the power of altering the angle and adapting the position of the kites to the strength of the wind was of the greatest importance. The tail, which had constantly to be added to or shortened, was always a nuisance, and it was a great thing to get rid of it altogether. With regard to the lifting power not being so great as they would require, he found when experimenting some years ago that by making a hole in the centre of the kite you actually gained power or pull. He found that if he made a centre hole and fastened the sides with india-rubber, which adapted itself to the strength of the wind to some extent, he got very favourable results. Another application which had not been mentioned was the saving of life at sea. A kite would occupy very little space, and if the sailors were properly drilled so as to use it, many a valuable life would be saved when a ship got on the rocks near shore. These things were all helping forward the time when we should be able to navigate the air. Practically a kite of this description was an aeroplane, and if a motor were substituted for the string, you would be independent of the ground. All the information gained in these researches would be of great value hereafter, and would bring us more rapidly to the goal of aerial navigation.

The Chairman said he was not at all surprised at Mr. Reid's statements that making a hole in the kite improved it, and it was satisfactory to think that if kites were used for warlike purposes, and the enemy's shot made holes in them they would fly all the better.

Captain Baden-Powell, in reply, said they were indebted to Mr. Maclure for the loan of the photographs, which had been shown, which were taken specially for his magazine. He had never seen Mr. Archibald's kite-balloon, but, theoretically it seemed to him that a kite and balloon combined had the disadvantages of both. If it were calm, the balloon would go better without the kite, and if it were windy the kite would go better without the balloon. He also, as honorary secretary of the Aeronautical Society, had received some papers relative to the conference at Strassburg, and should be glad to furnish any information with regard to it. He agreed that Mr. Marvin's pamphlet was a valuable contribution to the literature of this subject, but his bigger book went almost too deeply into theory, and arrived at some conclusions which were hardly warranted by experience. His experiments were almost confined to Hargrave kites, and a few of the Eddy shape. He recently had a letter from an officer on the Indian frontier, in which he said he wished he had some kites out there, and this was rather interesting after the remarks which had been made. He had stated that the model shown was not a real Hargrave kite: he only brought it to show the general idea. As to the crowd at Ipswich, he was glad to see that the public were so much interested in the matter, but must confess that he had the greatest difficulty in getting the people to leave the things alone, they were all so anxious to render assistance where it was not wanted. The result was he had several mishaps. There was some suggestion about danger in coming down, but he always had a parachute fixed above the car, so that in case of the cords breaking, it would come down gently.

Mr. Spencer asked if the fabric of the kite could not be so framed as to act as a parachute.

Captain Baden-Powell said that the idea had often occurred to him, and he had tried to arrange it, but was always met with this difficulty, that in order to make a satisfactory start it was necessary to have the weight to be lifted a long way from the kite; the kite ought to be about 100 feet up before it would do any useful work in lifting, and it would introduce great complication to work a parachute at that distance. He hoped many people would take up this subject and work at it; it was not only useful, but formed a very interesting amuse-

Digitized by Google

ment. He had even heard it said that it was better than golf.

The Chairman then proposed a cordial vote of thanks to Captain Baden-Powell, which was carried unanimously, and the meeting adjourned.

Twenty-four Hours in a Balloon.

A full account has recently been published * of one of the longest balloon voyages ever undertaken. (In point of duration it has been beaten at least once.) The ascent was made on October 19th last, at Leipzig, in the great balloon belonging to MM. L. Godard and E. Surcouf, which had been used for captive work throughout the summer at that place. At the close of the Exhibition it was decided to let the balloon go free. It was therefore specially fitted for the event, the large annular car being replaced by a smaller rectangular one. A novel feature was an "equilibriator" or guide rope of steel wire with a leaden core. This was 11 mm. in diameter, 50 metres long, weighing 25 kilogs, and was attached to the end of a hempen rope 100 metres long and 25 mm. diameter. A guide-rope of cocoa fibre, 80 metres long and 40 mm. diameter, was also taken, as well as the anchor cable, which had a breaking strain of 10,000 kilogs. (22,000 lbs.). An electric lamp was taken, also two barometers, two thermometers, a hydrometer, and other instruments. The weights were as follow :—

Balloon and equipment	2,849 lbs.
Eight people	1,331
Ballast, 49 bags of 55 lbs.	2,695
Printed papers, 10 packets of 55 lbs.	550
Personal baggage	176
Food and water (four meals)... ...	176
	7,777 lbs.

The gas, in spite of having been six months in the balloon, still had a lifting force of 69 lbs. per 1,000 cubic ft.

The balloon was in charge of M. L. Godard, with M. E. Taupin as assistant, and the following gentlemen who ascended: R. Meischke, O. Duncker, W. Paul, Prof. M. Krausé, M. Halfter, and R. Lencer.

At 5.15 p.m. the order to let go was given, and the balloon rose to a height of about 1,000 ft., and passed over the town of Leipzig. A light W.S.W. breeze was blowing about twenty miles an hour.

For the first two hours nothing special is recorded. At seven o'clock, when at 1,800 ft., dinner was served, and the aeronauts apparently did themselves well on cold partridge, champagne, &c. At 9 o'clock the speed was sensibly increasing, and lightning was noticed. At ten o'clock, the voyagers were between Berlin and Frankfurt, the lightning was flashing on both sides of them and peals of thunder were heard, but as they counted 30 seconds between the flashes and the claps they feared no danger. By half-past ten it was raining in torrents, and 300 lbs. of ballast had to be discharged to compensate for the weight of water on the balloon. The altitude was now only 500 ft, the storm increased in violence, and the lightning came closer. The speed of travel was now calculated to be 70 kilometres (43 miles) an hour. The aeronauts appear to have been having anything but a pleasant time. For two and a-half hours they were in the midst of a thunderstorm, "tired and very sad." By half-past twelve the lightning became less frequent, but the rain continued, and towards two o'clock they concluded that two hours more would carry them over the Baltic Sea. During the storm, 1,200 lbs. of ballast had been discharged, and the question was now put whether to make a descent or to continue the journey. M. Godard, after inspecting the ballast, declared he could remain another ten hours in the air, and as the Baltic was not more than 400 kilometres across, and that distance could be passed over in about six hours, it was decided to continue.

The balloon was now 1,200 metres up. But the spirits of its occupants required a little raising with champagne and cognac. The course of the balloon had now changed slightly more to the eastward, to the right of Königsberg At 5.30 the day dawned. There was a thick fog, though the guide ropes were on the ground, and the rain beating in under the balloon wetted its occupants, who had hitherto remained fairly protected by a collar round the balloon. A considerable speed was still being maintained, and the car swept into some fir trees, but by throwing out three bags of ballast an altitude of 4,000 ft. was soon after attained.

Towards nine o'clock a descent was made in order to determine the direction of the course. The end of the guide rope just

* *Ballon Captif de Leipzig.* L. Godard. Paris: L. Lambert.

trailed on the ground, and it was now found that the wind must be from the north. The country was well cultivated, and from the costumes of the peasants it was surmised that the voyagers were in Russia. The aeronauts were for some time unable to ascertain from the people their whereabouts until they recognised the name "Grodno." The speed was now 80 kilometres (49 miles) an hour, and the direction of the wind changed to E.N.E. At 10.30 more rain came on, and the ground was lost sight of. Several layers of clouds were passed through, and an elevation of 1,900 metres attained. A great dejeûner was partaken of at 11.15. Less than one-third of the ballast taken now remained, but a steady ascent was made as the sun shone out. At 2.20 a height of 3,240 metres (10,500 ft.) was reached, the maximum altitude of the journey; blue sky, thermometer 4 deg. C., and an immense carpet of cloud beneath, forming a grand spectacle. Soon after the balloon descended again into the clouds, and arrangements were begun to prepare for landing. The frontier of Russia was again crossed, and it seemed as though the balloon was making for home again. Rain commenced again whenever the voyagers approached the earth, but at 4.15, after a final toast had been drunk, all arranged themselves for the descent. Again the wind changed, and the balloon took a more southerly and then easterly course, passing just to the east of Breslau. At five o'clock both guide ropes were trailing. Several trees were "cut down" (*fauchés*) by the steel guide rope, which several times stopped the balloon, and the hemp rope, which united it to the car and which had a breaking strain of 3,850 kilos., broke. What remained of the guide ropes travelled well, but the balloon was progressing at a great speed—115 to 125 kilom. Only nine bags of ballast (225 kilogs.) remained. The balloon was passing over a large wood, and the car brushed the tree tops. As the edge of the wood was approached, Godard let go the anchor, and opened the valve. The balloon dragged on for a short distance, and then quietly collapsed, and a most satisfactory landing made. It was exactly 5.38, so that the journey had lasted just 24 hours 15 minutes. The descent was made within 600 metres of the village of Tarnau, Silesia. The distance travelled is estimated at 1,665 kilometres (1,032 miles).

NOTES.

International Commission for the Exploration of the High Atmosphere.—This Conference assembled on March 31st, at Strassburg, under the presidency of Dr. Hergesell. Reports of former ascents were to be described, and details of the methods of registration gone into. Balloon and kite ascents were also to be made. It is unfortunate that no English representative was able to attend. Mr. A. L. Rotch, of Blue Hill, represented America; M. de Fonvielle, and others, France We shall look forward with interest to the results of this Conference.

From London to France by Balloon.—Messrs. P. Spencer and George Griffith ascended on February 8th from the Crystal Palace, at 11.20 a.m. The Channel was reached, in the neighbourhood of Dungeness, at a quarter to one, the elevation then being 5,500 feet. The thirty miles to Boulogne took about an hour, the balloon passing directly over the harbour at a height of 6,000 feet. A steady rise took place over the land until 10.000 feet was attained. At about 3.20 a descent was made at Verchin, close to the field of Agincourt.

The Paris Exposition of 1900.—The following gentlemen have been appointed members of the Committee of Administration of Aerostation:—MM. Bouttiaux, Commanding 1st Co. of Aerostiers; Espitallier, Commanding Battalion of Engineers; W. de Fonvielle; Eugene Godard, Aeronaut; Henri Hervé, Aeronaut; J. Joubert, Meteorologist; Krebs, Major, Sapeurs Pompiers; Lachambre, Aeronaut; Lauriol, Engineer; Renard, Commanding Battalion Engineers; Sarran, Professor; Serpette, Naval Captain (late Commandant of Naval Aerostation Park); Tissandier, Aeronaut.

Army Estimates, 1898-99.—The amounts to be appropriated to military ballooning this year are:—Instructor in ballooning, £600; engineer stores, ballooning, £4,950; Aldershot balloon factory, £200. Total £5,750.

A New Navigable Balloon.—Mr. Douglas Neale is engaged in designing a new form of navigable balloon, which he proposes to experiment with shortly at the Alexandra Palace. It is said that the motor will be a steam engine of 25 horse-power, weighing less

Digitized by Google

than half a ton, the fuel being oil, and that a screw propeller will be placed in front of the "bow" of the balloon. But the inventor, not unnaturally, does not wish to publish further details of his scheme in its present uncertain stage.

An Aeroplane Propeller.—An interesting test is reported as having been made on November 30th of an aeroplane propeller, designed by Professor Langley, on the Mount Holly, Lumberton, and Medford branch of the Pennsylvania Railroad. The car used was of the jumper pattern, and weighed, together with its equipment, 3,800 pounds. On the rear of the car were two wings, in the shape of propeller blades, each about 9ft. from tip to tip. The framework was of wood. It was covered with stout muslin. The power was furnished by a gasoline engine of 6-horse power, which caused the wings to rotate. The start was made from the Pennsylvania railroad freight depot in Mount Holly. Prof. Langley was accompanied by Mr. J. E. Watkins, of the Smithsonian Institution, assistant train-master Walter Antrim, assistant supervisor Wisman, of the Pennsylvania railway, and two machinists. When the engine was started, the car travelled slowly at first, on an up-grade, but as a level piece of track was reached better time was made. The machinery worked smoothly, and the wings made 400 revolutions per minute, which gave the car a speed of between 5 and 6 miles an hour. One section of the road, between Mount Holly and Lumberton, was traversed several times, the result being the same, or substantially so, each time. The amount of energy developed has not yet been figured out. It was stated that another trial will be made over the same road by Professor Langley in a day or two, on which occasion the size of the wings may be changed and the pitch altered.—*Machinery.*

The Blue Hill Meteorological Kite Observations.—Regular bulletins are now issued, of which we have received two numbers, giving details of the ascents and facsimiles of the "Meteorograms," or registers of the instruments used.

Eddy's "House" Kites.—Mr. W. A. Eddy sends us an account of his latest device in kites. These are shaped exactly like a small house with gable roof, the bridle being attached underneath the floor. Mr. Eddy says "the apex of the roof of the kite has great buoyancy which I am obliged to offset by decided convexities in the lower floor of the kite." They are constructed with a framework of light spruce sticks and a covering of paper, and are about three feet square.

Scientific Ballooning.—In order to test the accuracy of the formula of Laplace for deriving the altitude of a balloon, &c., from the barometric record, Cailletet, to whose ingenious apparatus for collecting air samples we referred in our articles on "Scientific Ballooning," has devised a photographic camera which has been constructed by Gaumont. A prismatic box is suspended from the balloon. Lenses are inserted in the lower and in the upper face. Between the two a band of sensitised celluloid is moved by a clockwork and exposed at regular intervals. The one lens produces an image of the scenery down below on the earth, the other of the needle of the barometer, whose point appears near the centre of the plate, which has a size of 13 by 18 centimetres (5 in. by 7 in.). From the distance on the plate between two prominent objects on the ground the height of the balloon can be derived. Satisfactory experiments having been made with this apparatus on the Eiffel Tower, Hermite and Besançon took it up with them on October 21 in their new balloon of 1,700 cubic metres capacity, a gift of the Russian scientist, Balaschof. The weather was tempestuous, and the balloon descended after a trip of four hours, having attained an altitude of 2,500 metres. The camera is said to have answered very well; 26 photographs were obtained. The apparatus is now to be secured against the influences of very low temperatures.

Balloon and Tramcar Collide.—A rare and sensational mishap occurred some time ago on the Templehof field, Berlin. In the yard of the Military Aeronautic Department two balloons stood ready to be let loose. One was a "captive," and secured to its cable car, the other was being held down by soldiers. All at once a strong gust of wind seized the free balloon, wrenched it out of the soldiers' hands, and carried it off with lightning speed into the clouds. Almost at the same time the second balloon was caught away, and dragged the car at a tremendous speed out of the barrack yard and across the Templehof field. In crossing the high road it collided with a fearful crash with a tramcar, which was upset. It is wonderful that, although there were five passengers in the car, no one was injured. Two soldiers who

Digitized by Google

had been dragged some little distance by the balloon was slightly hurt. The other balloon was reported to have crossed the Russian frontier about noon.

Balloon Net of Spiders' Web.—According to the *Temps* correspondent at Antananarivo, a special fine net made entirely of spiders' webs, is being manufactured in the professional school at Antananarivo. The process is a very simple one. The thread of several dozen spiders is wound on winders, the quantity produced by each spider ranging from 15 to 40 yards. The covering of the web is removed by repeated washing, and the web made into a thread of eight strands. When the thread is spun it is easily woven into a gauze which is very fine but very strong. It is to be used for an experimental covering of a navigable balloon by M. Renard, the head of the French military balloon school at Chalais, near Paris, who has been engaged for many years in experimenting in aerial navigation. It is believed that the difference in the weight of an ordinary covering and the spiders' web net will make a great improvement.—*Dalziel.*

Recent Publications.

Stories of Balloon Adventures (F. Mundell. London: Sunday School Union, 1s. 6d.), is merely a popular account of startling and adventurous balloon journeys, fancifully illustrated.

Exploration of the Air by Means of Kites is a new publication by the Blue Hill Meteorological Observatory. It is divided into three parts. The first on "Kites and Instruments," by S. P. Fergusson, gives a short historical sketch of the subject, followed by details of the construction of the kites used in the experiments, as well as the various instruments. Then follows a series of tables, giving the results from the Kite Meteorographs, while the third part consists of a discussion of the records by H. Helm Clayton. The work is carefully got up, with good illustrations and numerous diagrams, and is worth careful study by all kite flyers.

Andrée and his Balloons (Westminster: A. Constable & Co., 6s.), from the French of Henri Lachambre, who built the balloon, and A. Machuron, his assistant, who was present at the start. This book, giving a complete history of Andrée and the balloon in which he has ascended, is somewhat disappointing in several respects. It is fully illustrated by a number of good photographs, but many of them are of no special interest, and several good photographs have appeared elsewhere which might well have been included to make the book complete. The frontispiece is a rather fanciful coloured sketch, and no map is given. Another matter is unsatisfactory—newspaper reports at the time gave various versions of the pigeon message received from Andrée, and in this book two quite different versions are given at pages 10 and 306, and it is on this point that reliable information is required. A facsimile of the message is reproduced, which we suppose must settle the matter, the appended translation being "good journey eastwards, 10° south," but if this is so, why put in the words (on page 10) "good progress towards the north"? A good deal of the book is occupied with M. Lachambre's personal feelings and doings during his journey to Spitzbergen in 1896. On the whole, however, this is a most interesting and complete account of this unique and extraordinary Polar expedition, and should form a necessary addition to the library of every aeronaut.

Foreign Aeronautical Periodicals.

L'Aeronaute (Paris), *January:* "Our Thirty-first Year," by W. de Fonvielle, recounting briefly what has happened since this journal was first started in 1868. "Three Ascents of the Balloon, 'Pégase.'" A letter from L. Godard with reference to the balloon journey of 24 hours.

February: "On the Minimum Effort Necessary to Sustain a Flying Apparatus." Note by Capt. Marcotti on Viscomte Decazes' paper. "Lessons to the Pupils of the French School of Aerial Navigation—Heat." Extracts translated from Major Moore's paper. A communication from Colonel Touche on "Calculations of the Resistance of the Air."

Digitized by Google

March: "Ascent of a Balloon of 750 Cubic Meters." New Method of Producing Hydrogen. Hofman's Aeroplane.

LA FRANCE AERIENNE (Paris), 1—15 *January:* "Study of the Means to Employ to Attain the Triumph of the Resistance of the Air." Long article by Jobert. "The Conquest of the Air by the Direction of Balloons."

1—15 *February:* "Aeronautics from Day to Day." "The Wind."

1—15 *March:* "Philosophy of Aerial Navigation," (continued), J. Corelli. "Wings! Wings!" by M. C. Du Pouey.

15—31 *March:* "An Aerial Voyage," by R. Bouchard (continued).

ILLUSTRIRTE AERONAUTISCHE MITTHEILUNGEN (Strassburg), *January:* "Leonhard Sohncke," life, with portrait. "American Gliding Experiments," O. Chanute (illustrated), in English and German. "Taking the Temperature at Heights." "The Equipment of the Balloon Section," by Lieut. Hinterstoisser, Commandant of the Military Aeronautical Establishment. "The Elongated Balloon and Experiments with the Aluminium Balloons in Berlin," (illustrated). "New Kite Experiments at the Blue Hill Observatory," A. L Rotch (in English). "The History of the International Balloon Ascents," by Dr. Hergesell. "The Mechanical Principle of Soaring Flight." "Opinions on the Design of Aerial Apparatus." Notes, &c.

ZEITSCHRIFT FUR LUFTSCHIFFAHRT. *February:* "On the Influence of Vertical Wind Currents on the Behaviour of Free Balloons," H. B. von Siegsfeld. "Flight—Particularly that of Birds and Insects," Mentz. "The History of the International Balloon Ascents," Prof. Assmann. Notes.

Notable Articles.

Jan. *Revue Scientifique* (Paris). — "The Schwarz Balloon;" "An Ascension of Twenty-four Hours."

11. *Machinery.*—"An Aeroplane Propeller." Prof. LANGLEY.

11. *English Mechanic.*—"The New Guidable Balloon, &c." E. WILSON.

21. *Engineer*—"Soaring Birds." Major FULLERTON

Feb. *Cassier's Magazine.* "A Balloon Railway."

Organ der Militär-wissenschaftlichen Vereine (Vienna).—"Ballooning in the Naval Service."

10. *Daily Chronicle.*—"Ballooning Across the Channel."

12. *Daily Chronicle.*—"New Flying Machine." Mr. Neil's dirigible balloon.

14. *New York Herald.*—"Eddy's New House Kites." (Illustrated.)

26. *Deutsche Heeres-Zeitung* (Berlin).—"The Influence of Ballooning in the Wars of the Future."

Mar. *McClure's Magazine.*—"Letters from the Andrée Party," and "Where is Andrée?" Two good articles, with numerous excellent and interesting illustrations from photographs.

Mar. 4. *Journal of the Society of Arts.*—"Kites: Their Theory and Practice." Capt. BADEN-POWELL. (Reprinted in this journal.)

10. *Morning Leader.*—"In Search of Andrée." (Illustrated.) Godard's new scheme.

16. *Cassell's Saturday Journal.*—"Shall we Ever be Able to Fly?"

Applications for Patents.

131. January 3. GRAF FERDINAND VON ZEPPELIN. **Improvements in and Relating to Navigable Balloons.**

304. January 5. THOMAS HAWKINS and FRANK S. D. SCOTT. **Improvements in or Relating to Aerial Ships or Vessels.**

557. January 8. WILLIAM CAIRD LINDSAY, Glasgow. **Fan Action Suitable for Aerial Locomotion, &c.**

2,986. February 5. L. W. BRONDWELL (A. WECZERA, Hungary). **Improvements in Flying Machines.**

3,515. February 12. LEONARD S. BLACKDEN, Cambridge. **Flying Machine Balancing Gear.**

3,922. February 16. NILS PEARSON THEANDER. **Improvements in Driving Chains and Chain Wheels for Flying Machines and other Driving Gear.**

4,257. February 21. DOUGLAS NEALE, Edinburgh. **Improvements in Navigable Balloons.**

4,258. February 21. DOUGLAS NEALE, Edinburgh. **Improvements in Machinery for Propelling and Steering Air Vessels.**

4,842. February 28. JAMES ST. CLAIR LEGGE, Dublin. **A New Motive Power for Motor Cars, Flying Machines, and the like.**

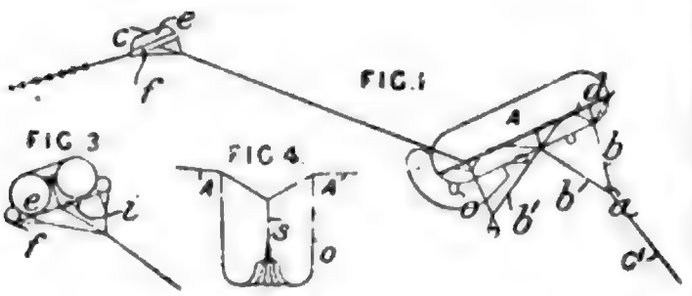
5,499. March 7. FREDERICK W. BENNETT, Penge. **An Improved Machine for Propelling a Balloon.**

7,214. March 25. CHARLES RITZINGER. **Improvement of a Parachute for Escaping from Fire and Accidents of Aeronautical Workers.**

Patent Published.

From the *Illustrated Official Journal.*

19,978. September 9, 1896. **Captive Balloons** RIEDINGER, A., Eisenhammerstrasse 23, Augsburg, Germany.



Relates to the invention described in Specification No. 18,773, A.D. 1895. To a girdle *d* is attached a robe *b*, which passes around a pulley *a* on the holding down rope C¹; the ends of the rope *b* are secured at the windward end and near the middle of the length of the balloon A respectively; the car is supported by a similar rope *b*¹ attached to the middle and leeward end. The apparatus is steadied by a kite or aerostat C, comprising two annular buoyant chambers *e*, *f*, covered with a fabric which is kept distended by air entering through *i*. The ropes are attached as shown in Fig. 3, and the apparatus may be provided with a tail. Safety valves *o* on the balloon A comprise a sleeve O, Fig. 4, the end of which is turned in and secured by elastic cords S; an abnormal rise in pressure stretches the cords and opens the end of the sleeve.

United States Patents.

598,038. January 25. C S. WARDWELL, Stamford, Conn. **Foldable Kite.**

598,777. February 8. C. J. GREINER, St. Louis, Mo. **Multiplane Kite.**

French Patents.

(Class VI., 3.)

270,264. HERKENRATH. **Aerostat with Radiating Gas Chambers.**

271,505. DANILEVSKY. **System of Aerial Apparatus.**

271,512. VARICLE. **Means of Directing Balloons to Deviate from the Aerial Current.**

271,948. ADER. **Dirigeable Balloon.**

272,572. KOCH. **Apparatus for Aviation, with Fixed Wings and Paddle Wheels.**

German Patents.

(Class 77.)

APPLICATIONS.

Z. 2,072. COUNT F. ZEPPELIN, Stuttgart. **Elongated Aerial Apparatus with Lifting Vessels Arranged One Behind Another.**

B. 19,051. Dr. R. BEENEN, Dresden. **Transposing Contrivance for Flying Apparatus.**

R. 10,842. Dr. H. RUDOLPH, St. Goars hausen. **Captive Balloon with Kite Plane.**

Digitized by Google

TL 20.5
.A245

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH
AUG 4 19

THE AERONAUTICAL JOURNAL



No. 7. JULY, 1898. VOL. II.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	51
MEETING OF THE AERONAUTICAL SOCIETY. Mr. G. DAVIDSON ON "THE FLYING MACHINE OF THE FUTURE." Mr. J. MARSHALL ON "MECHANICAL FLIGHT."	51
GAUDRON'S NAVIGABLE BALLOON. (*Illustrated*)	60
THE INTERNATIONAL AERONAUTICAL CONFERENCE AT STRASBURG	61
WISE'S PHOTOGRAPHIC KITES. (*Illustrated*)	63
A NEW FORM OF KITE. C. ZIMMERMAN. (*Illustrated*)	64
SCIENTIFIC BALLOON ASCENTS	65
OBITUARY: Mr. H. PERIGAL. M. H. DE VILLENEUVE	67
NOTES: ACROSS AFRICA BY BALLOON—ADER'S FLYING MACHINE—KITES FOR METEOROLOGY—VARICLE'S BALLOON FOR KLONDIKE—A PROJECTED SCIENTIFIC ASCENT—GREAT HEIGHTS—KITE TELEPHONES IN THE NAVY (?)	67
FOREIGN AERONAUTICAL PERIODICALS	69
NOTABLE ARTICLES	69
APPLICATIONS FOR PATENTS — PATENTS PUBLISHED — FOREIGN PATENTS— RECENT GERMAN PATENTS..	70

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

From H. LACHAMBRE, Paris. ✤✤ *Established in England 12 years.*

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform Ladies and Gentlemen that from May to October, 1898, he will be making Bi-weekly Ascents at the Alexandra Palace, and intending Aerial Excursionists may obtain particulars of these Ascents by applying to

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCULLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JULY, 1898.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICE TO SUBSCRIBERS AND OTHERS.

It has been decided that the sphere of usefulness of this Journal will be greatly enlarged if the price be reduced. In future, therefore, the price will be **ONE SHILLING** per copy. Unless, however, the circulation increases in proportion, it will be impossible to maintain this Journal, at all events in its present form. All those interested in this subject are therefore earnestly requested to do all they can to increase the circulation of the Journal, and to send their subscription (four shillings) to the publishers, instead of relying on seeing the publication in a public library or other institution. Those who have already sent subscriptions for the year will be entitled to two more numbers of the Journal.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on June 24th, when the following gentlemen were elected Members of the Society:—

Capt. the Hon. L. KING-NOEL, Horsley Towers, Leatherhead.

H. WILSON FOX, Esq., 15, St. Swithin's Lane, E.C.

The Right Hon. Viscount MOUNTMORRES, Junior Carlton Club, S.W.

Lieut.-Colonel G. LE M. TAYLOR, 6, College Lawn, Cheltenham.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Meeting of the Aeronautical Society.

A MEETING of the Aeronautical Society was held on June 24th, at 4.30 p.m., in the Hall of the Society of Arts. Viscount Mountmorres was in the chair, and there was a large attendance of visitors. After a statement had been made by the Honorary Secretary referring to the satisfactory progress of the Society, the following Paper was read by Mr. Davidson, numerous Photographs being thrown on the screen to illustrate the lecture.

THE FLYING MACHINE OF THE FUTURE.

The subject of my paper to-day, namely, "Mechanical Flight," has no doubt until quite recently been considered with much ridicule, and it is probable the greater number of the public are of opinion that the problem is still a long way from being practically solved. I trust, however, that I may be able to go a certain distance this afternoon towards convincing you that travelling swiftly and safely by air is not the mere dream of sanguine inventors, like myself, but is fast approaching the practical; and I hope to interest you in the subject by suggesting a few of the probable uses to which the air-car of the future will be put, whilst, at the same time, I will endeavour to correct some of the generally accepted, but, I sincerely believe, erroneous, ideas of what successful mechanical flight means. These ideas given forth by those who have not really studied the question in relation to the laws of nature are very much to blame for causing the ridicule to which I have just referred.

For instance, many of my friends suggest that there is at least one important and redeeming feature in connection with my own personal efforts at the solution of the problem. They call it an important and redeeming feature, because they believe it will prevent my coming very seriously to grief, or hurting anyone else, namely, my determination to start my air-car from the level of the ground, and not to attempt a flight from the top of St. Paul's or the Eiffel Tower, as many imagine is the correct manner of starting the first flying machine. The general public

Digitized by Google

appear to ignore the mere fact of the necessity of getting up to those lofty pinnacles before starting to fly down. At any rate, I think it will be admitted in regard to my air-car that it cannot possibly fall if it has not first risen, and, if by its power it is capable of rising even a few feet from the ground, then one very important part of the problem will have been materially advanced. I hope this afternoon to convince you that I have absolutely proved that with the present-day mechanical appliances and engineering skill we are now perfectly capable of constructing a structure that will lift itself by its own energy into the air, and as it has long been proved by the gliding machines, to which I will refer later on, that a large structure can be made to support heavy weights by gliding through the air; then, if we combine the two, and cause the equilibrium to be absolutely maintained by automatic means, you will have the "flying machine of the future."

AIR-CAR. The air to us is still, if I may so call it, a vast undiscovered dominion. A few plucky pioneers, with balloons and other rough and unready means have to a certain extent been successful in their attempts to explore and investigate the nature of this great highway, but they have met with a considerable number of disasters—and for why? I suggest as a very simple reason that the effects have been individual, and not collective; that as yet there has been no properly organised and sufficiently well backed-up endeavour to deal with the problem upon a practical scale, and enable theorists and inventors to combine with first-class engineers capable of designing practical and common-sense appliances to act in accordance both with the laws of nature as regards flight and the laws of mechanics.

Up to the present time we have used the power of the air for working windmills, blowing along our sailing ships, and even wafting from place to place, with a total and consummate disregard for the wishes of the occupants, those stupendously impractical aeronautical implements called balloons. Are we to stop at this, and not to attempt to apply this air, one of the most powerful of nature's forces, to our further requirements? Are we to leave it alone, that we may merely witness its great power in the periodical devastation it causes? You have all seen what the power of the air can do, has done, and yet it seems to be the generally accepted idea that in spite of the fact of the air having this great power, we, for some unexplained reason, must necessarily be incapable of using that power for locomotion. The fact is, our minds, as a rule, are saturated with preconceived ideas, and because we know ships float in water, owing to the ships being lighter than the volume of water their bulk would displace, many insist that we cannot possibly fly unless we make a machine which is also lighter than the air it displaces.

BIRDS. Those Birds you see depicted as flying through the air are, you will all admit, much heavier than the air they displace, and they are only permitted to fly and be sustained by the air on condition they comply with the laws of nature. I do not wish to be thought dogmatic, but I assert that a machine made by man will also fly if it is constructed so as to comply with the same laws of nature with which those birds comply. Then comes the question, How are we to construct a machine which by mechanical means will comply with the requirements of nature? Certainly we cannot attempt to construct such a machine and make a certainty of success unless we first find out what the requirements of nature are, and I therefore suggest, it is absolute waste of money to experiment with machines of any sort designed for aerial purposes by persons who have not studied or been instructed in the conditions of natural flight, and who cannot truthfully say, "We know how birds fly."

I trust, however, no one here will go away under the impression that it is for a moment suggested by me that we should exactly follow out the intermittent or reciprocal movements of the wings of a bird if we wish to fly by mechanical means. It is, I believe, usual in all mechanical appliances, if power be a consideration, to resort to a rotary movement, and this rotary movement must attain the same result, and do similar work to the intermittent or reciprocal movement of nature.

The wheel of the locomotive has a grip of the rail by gravity owing to the weight of the locomotive, and the wheel being forced forward by the internal power contained in the locomotive to obtain a grip of the rail further forward, carries out the same principle by a rotary movement as the natural movement of the man or animal is carried out intermittently or reciprocally by the man or animal having a grip of the ground with the feet, and by internal force obtaining a grip of the ground further forward with the other foot or feet. Again, the steamer, with its rotary screw propeller, is pushed through the water on the same principle as by the intermittent, or reciprocal, motion of the fish's tail the fish is pushed forward. I do not propose this evening to enter into a detailed explanation of the intermittent or reciprocal movement of the wings and tail

of birds; but I will suggest for your consideration what I believe everyone admits a bird does not do, namely, that no bird or flying creature has any motion reciprocal or otherwise by which it attempts to screw itself horizontally through the air, as a fish screws itself through water with its tail; and I respectfully submit it is absolutely at variance with the laws of nature to employ as a substitute for the reciprocal action of the wings of birds, a screw propeller or propellers designed to push a structure horizontally through the air by pushing against that air as a propeller pushes against water, even should the structure be fitted with or built in the form of aeroplanes or aerocurves to give support. That however, seems to be the general line of experiment during the last few years, and although a certain amount of success has been attained, as may be seen by Prof. Langley's aerodrome, which has travelled through the air by its own energy a distance of three-quarters of a mile, still I must ask you to pardon me for saying this is not flight. Prof. Langley's aerodrome was anticipated some forty years ago in this country by Mr. Stringfellow, also with partially successful results; and Mr. Maxim's late attempts upon a larger scale were apparently much upon the same principle, namely, the principle upon which a fish travels in water. Now, we all know that a fish out of the water is a very helpless and impracticable creature, and the same might apply to all such mechanical appliances for travelling through the air by means of screws designed to propel horizontally as in water, and, although it may seem presumptuous on my part to be so emphatic as to the error and uselessness of these experiments, which have been carried out by men who are recognised as scientists, still I cannot help saying I am quite convinced that no more practical results will be attained by these aerodromes driven through the air by propellers than is now attained by balloons, and I must admit I am only too pleased when I read of what is designated as a new flying machine, and see that a balloon is an essential part, or that it is pushed horizontally by propellers, for I then know that I need fear no competition from the inventor.

LANGLEY'S.

MAXIM'S

Had an assemblage such as is here to-night been gathered together one hundred years ago, or even less, what would they have said and thought had they been told that they would soon be travelling about the country, and be able to go, say, from London to Edinburgh in eight hours, dragged along by an inanimate steam engine. Very likely they would have thought it a great deal more impossible of accomplishment than when I now tell you that you are just upon the verge of a new revolution in travelling, and that you may soon expect to be able to go, not only from London to Edinburgh, but, say, from London to the Riviera probably in less than eight hours, gliding safely through the air.

Perhaps you may think *my* suggestions are wild, but I can assure you they are not half so wild as the general ideas of the public as to what mechanical flight will mean. So many suggest that we may each have a pair of wings in the same way as we now have bicycles, and go flying off to a garden party to meet our friends hopping about the lawn. I could tell you any number of the absurd notions with regard to flight suggested to me by those who, whilst they inwardly believe in the possibility and probability of travelling through the air by mechanical means, yet have not the slightest idea of the form mechanical flight will take, nor the uses to which it will be put, for the very good reason either from want of time or inclination, they have not studied or given any serious attention to the subject. One very general impression I may mention is, that the main object of flying machines will be to enable us to drop dynamite from the clouds upon our enemies. This, no doubt, we shall be able to do, but it will not be the sole raison d'être of the flying machine, and in making a few suggestions as to what I hope you may all live to witness, I would ask you to bear in mind that these forecasts are not the visions of a mere dreamer, but of one who has studied the subject for upwards of sixteen years.

I now propose to describe a few of the features and incidents of travelling through the air as we may expect them when the problem of mechanical flight has been satisfactorily and practically solved. First of all, you may rely upon it that the flying machine of the future will be a very large structure, and will not be able to settle down in a back garden, or alight on the window-sill. It may certainly descend on any large and level open space, but when used as a practical means of locomotion, and to be of value from a commercial point of view, large depots will have to be established, from which the air cars will start, and where they may arrive and be housed or docked just as now we have railway stations and docks for our trains and our steamships. In crowded cities these depots may take the form of enormous platforms similar to what the tower at Wembley Park now is, and the cars when not in use

Digitized by Google

can return to rest and clean up, or undergo repairs at a spot some distance away in the country, where space is not too valuable. There will probably be larger depots within convenient distance of London and other centres, from whence ocean-going and long-distance cars will start, and instead of, as now, taking a cab drawn by some poor, broken-down quadruped to the railway station when you wish to travel to the north, you will press an electric button and a motor car will shortly attend to take you, say, to the Great Northern Depot, after looking up the A.B.C. Airway Guide for information as to the time of starting to suit your convenience. You, perhaps, may wish to go to Manchester, taking the 12 o'clock car, and without the jar and jolt of the railway train, and most certainly without the noise, the rattle and the dust, you will glide gently away, hardly knowing whether or not you have started until you look out of the window and see you have left the ground far beneath, and you should arrive in Manchester in good time for a one o'clock lunch, and you will have ample time to stay for afternoon tea, and to get back to London for dinner. There are endless possibilities open for the use and development of the air car of the future, but I can quite imagine you all say within yourselves, "How can it be safe?" And yet, I can most emphatically assure you it will be just as safe, if not safer, than travelling by train or steamship, and I fully admit, and have never during all these sixteen years lost sight of the very important fact, that it is absolutely useless even to experiment with a machine that is not constructed in such a way as to be automatically steady and as safe as an ordinary four-wheeler; I even go so far as to say that I certainly would not wish to travel in an air car myself if it is liable to come to grief as often, or to cause as many fatal accidents as an ordinary hansom cab or a top-heavy 'bus, and yet most of you have no hesitation in travelling in those dangerous vehicles simply because the average number of fatal accidents is comparatively small. The motion of the car may not be quite steady in very tempestuous and gusty weather, and if you must necessarily travel on such occasions, it is quite probable you may experience qualms similar to those we have most of us felt when crossing the Channel in boats like the Petrel or the Foam, with which many of you are familiar. When, however, travelling from London to New York becomes a matter of hours instead of days, and you will recollect it used to be weeks, and formerly even months, we need not be particular as to the day of starting upon so short a voyage, and in any case we shall have much more accurate and up-to-date reports as to the state of the weather over the Atlantic brought to us by the various air cars flying to and fro, and by means of the barometer and other scientific instruments we may be able to fly pretty clear of whirlwinds or waterspouts, whilst we can generally manage to keep well above any fogs which may be causing delay to those obsolete cargo boats, in which category, no doubt, the Campania may soon rank. Those who can afford it will be able to travel about the world in private and luxurious air-cars, but I do not suggest they will be as common as bicycles, carriages, motor cars, or even as steam yachts are now; and I hope what I have said this afternoon will go some way towards disabusing people of the idea that they may be able to keep a flying machine ready on the balcony, any more than we now would take our yachts up a salmon river, or travel about the house in a railway train. The air yachts, however, will be a great deal more convenient in many respects than the corresponding water palaces to be seen about Cowes in July, inasmuch as there need be no necessity to descend at a public depot, or to keep only to the borders of the ocean. The millionaire who indulges in an air yacht must, however, arrange to have a proper car house for his machine at his residence in the country, and he will not be able to keep it at the back of his mansion in town for a fly round the Park in the morning. He will, however, have the convenience of being able to visit those of his friends in the country who have available open spaces properly adapted for the landing of an air car, and he will be able to land on any part of the world where he can find a fairly large and level piece of ground not encumbered with trees. The sands along the seashores and large and level fields will generally afford a convenient place to alight, but in landing at these unprepared places more care will be required when a strong wind is blowing than in a place where men are ready to catch the ropes necessary to at once attach the beak and forepart of the car to the ground.

Now, a few words as to dropping dynamite and other equally obnoxious habits that the air car may probably acquire. The flying machine of the future will most certainly be a terrible engine of destruction in the hands of the unscrupulous, and no doubt we, as a nation, or, at any rate, as the English-speaking race, shall have to maintain the supremacy of the air as now we must of the sea. It is possible we may have to keep an aerial or real

flying squadron in commission, and this should, for the security of the nation, be done from the very first moment the air has been brought under the control of man for practical travelling. If a German, Frenchman, or a Russian be the first to succeed, woe betide this country, but if we British are the first to succeed then we know that we can use the command of such a terrible power with justice and impartiality. It may be necessary, by treaty or otherwise, to make it to be considered an act of war against the British Empire for any other nation to attempt to construct a war air car, and if they do make such an attempt in defiance of all agreement, it is unlikely, in these days of telegraphic information, that we shall not hear in good time to enable our aerial fleet to proceed to the spot and demolish the machine and the works where it is being constructed long before its completion. In fact, there are many ways in which we may be able to retain the control of the air, provided we are the first to obtain the command, and I hope you will recognise that it is the duty of all patriots to help towards the consummation of such a state of affairs, for once the first air car has successfully shown that it is capable of rapid, certain, and safe flight, and is completely under control, it must soon come into general use, and for long distance passenger traffic take the place of the express train and the ocean-going steamship, just as the railway train and the steamship have taken the place of the mail coach and the sailing vessel.

So much for the future. Now a few words on the past, and then I will tell you something of what I know of the present state of the aerial problem, and relate some of the results of my experiments. The balloon is a thing of the past. I hope I am not offending anyone, but it is quite evident to those who are now really studying the subject that the balloon for travelling by air is impracticable. It still has its uses for war purposes, but only because a successful flying machine has not yet been constructed; when that is done Balloonists will have to collapse.

At present clever and scientific men in every country are working at the problem, but as far as I can gather they all with one accord have taken to the principle of pushing a structure through the air by propellers on the same principle as a fish in water. I do not profess to be the first to think of raising a structure in the air by rotary lifters. I do not profess to be the first to think of designing a machine that will glide forward through the air; but I do most emphatically declare that to the best of my belief I was, and am, the first to attempt to combine the two, and to add an automatic method of retaining equilibrium.

GLIDING MACHINES.

Lilienthal's, Chanute's, and Pilchers gliding machines, these show you that with an out-spread surface of sufficient dimensions to prevent a vertical fall, the action of gravity draws the structure forward, and it glides down an inclined plane of air, but all these gentlemen have to trundle their machines up to the top of a hill before they begin to glide. One gentleman I know is now designing a machine by which he hopes, by pushing with a propeller from behind, to glide up the incline against gravity instead of down the incline with gravity, but I think he will find it difficult I, in my machine, have two sets of aerocurves, rotary aerocurves, inside the fixed outspread aerocurves, and these rotary aerocurves I force through the air at an angle upwards by energy applied direct from the engines, and thus get my vertical lift, which is tantamount to trundling the whole structure up a hill, only that I can continually keep trundling it up, and with my fixed aerocurves I have the support when gliding forward down the hill again by the action of gravity, and because I am able by adjusting the automatic equilibrium gear to maintain any inclination I desire, I can thus increase or diminish the speed. From the birds, and also from the experiences of the gliding fraternity, I have been able to calculate the extent of the structure necessary in order that the air may support the weight of this air car, which I hope to construct, and I have had a general drawing made by an experienced engineer, who has calculated all the weights, stresses and strains, so that you may rely upon it the main structure is quite practical.

DRAWINGS.

I will now show you what may give you a general idea of the nature of this air-car. First is the entire air-car as it will appear from in front; second, looking at it from one side; third is a longitudinal section of the body or car; and fourth is a plan of the upper and lower compartments of the car. There is not much difficulty about the designing of a structure for gliding purposes only, but to include in that structure rotary lifters capable of lifting the entire weight, it was absolutely necessary to carry out a series of experiments to ascertain what horse power is required, and with what diameter of lifter, what shape is efficient, and what is the best speed at which to drive these rotary aerocurves through the air and get the required lift. Through the kindness of Lord Crawford, Mr.

Digitized by Google

Harry Weber and others, who furnished me with funds, I have been able to experiment, and I have now got a satisfactory shaped lifter that will lift even at so small a diam. as 4ft. a weight greater than the weight required for the structure to contain that rotary lifter, together with the energy necessary to drive the lifter and give that lift. It has also been ascertained without doubt, that the larger the diam. of lifter the more efficient it is, and I anticipate with the lifters necessary to lift the machine, I have shown to you, I shall find I have a very much greater margin than I am calculating upon. These last slides will show you some of the results of experiments with one of the satisfactory lifters, taking different diams., 2ft., 3ft., and 4ft., but I have since improved on these. I can get the lift, I can get the support, and I have the automatic arrangement to ensure safety, and maintain the angle which enables gravity to act, and give the forward movement. All I want is the £ s. d. to construct a practical full-sized machine, and there are millions in it when completed.

I close my remarks for this evening by repeating, it is absolutely essential for the peace of the world that the English-speaking race shall be the first to obtain and shall be the paramount power to retain the supremacy of the air, by constructing the first successful flying machine of the future, and you must all help.

Mr. Davidson then proceeded to show one of his four-bladed rotary aerocurves in the act of revolving and lifting itself with a weight attached into the air.

Mr. P. Pilcher questioned the desirability of using the word "lifter" for an appliance already well known as a "propeller" or "screw" mounted vertically. He considered it most desirable to make a careful study of all statistics relating to aerodynamics. For instance, the pressure of the wind on various surfaces had received but little attention from experimenters, and very much was to be learnt from any observations in this line. Anyone who had noted any points likely to be of interest should send the results of their observations to the Hon. Secretary of this Society. Mr. Pilcher also doubted the advantage of constructing a very large apparatus. Thus a little paper model could easily be made to fly, but as the size is increased, difficulties of construction also increase, for as the linear dimensions grow, the thickness also requires to be greater and consequently the weight, so that as the machine becomes larger its weight increases in a greater proportion. Then also it becomes a matter of great difficulty to automatically balance any large machine, and this is a point of great importance. What is known as a "soaring machine," to carry one man, has been constructed with the special object of practising this balancing, especially in landing, and such a machine with suitable engines and propellers, would seem to be the best form of flying machine. To make a large flying-machine without previous experience presents great difficulties. Who could design and practically construct and balance a 10-ton bicycle? We should consult Nature.

Mr. Middleton asked whether consideration had been made of the action of the vertical screw propellers while in rapid horizontal translation. The stream lines of air would, he thought, attack the blades of the propellers inefficiently.

Mr. Walker stated that he had been connected with Mr. Davidson in carrying out these experiments with "lifters." These models had been tested with a tip speed varying from 5 to 200 miles per hour. The object of the experiments was to ascertain what the propellers could do. At first forms were tried, which proved of but little efficiency. Some twenty-eight propellers had been experimented with, and now they had arrived at a pattern which certainly was of considerable efficiency. The experiments clearly show that these lifters can be made not only to lift themselves, but also the machinery necessary to drive them. Thus a 4-foot propeller had been made which lifted 48 lbs. per horse power. Machinery has been made weighing 10 lbs. per horse power. He was not aware that any similar experiments had been carried out in any part of the world.

Mr. W. F. Reid asked how the machine was to be prevented from rotating. They had heard about the weight which could be lifted per horse power, but he would like to know what number of revolutions were given to the propellers. He thought that it would be found that if the solid boss were cut away from the centre of the propellers, a better result would be obtained. Some people were given to introducing abstruse mathematics into the question. He did not believe that such would assist to forward the subject, in its present state, any more than balloons did. It was not by mathematics that we got ships' propellers to their present state of efficiency.

Mr. Brownjohn, Mr. Watson, and others having spoken,

Mr. Davidson, in reply to several questions, said that he did not care whether the appliances were spoken of as "lifters" or "propellers." He was perfectly willing to call them what they

Digitized by Google

liked. But the term "lifter" was suggestive of the distinction between the propellers to lift vertically as compared to those intended to drive horizontally. As to the size of the machine, he came to the conclusion, after much consideration, that it was better to make it very large, else the carrying power was so small. He had been consulting Nature for the last 16 years, but now had come the time for consulting engineers, though he found it rather more expensive. The machine would not rotate, as there would be at least two screws, one on each side of the structure, turning in different directions. He could have given many details concerning the number of revolutions per minute, etc., but they would exercise the patience of the audience. The apparatus would be perfectly manageable, even in a gale. Indeed, the landing could be better effected in a strong wind than in a calm, as, by heading the wind, the swiftly-travelling machine could be brought to a standstill before it touched the ground.

The paper, by Mr. J. Marshall, was taken as read, there being no more time available.

Mechanical Flight.

In an endeavour to give a plain statement or explanation of my theory relative to aerostation and flying machines, I may at once state that I give preference to such machines as depend on the vertical flapping of wings for their elevation and propulsion; and, although such have given hitherto the least promise of success, I think I shall be able to show that the fault lies more in the construction of the wings, and the mistaken application of the necessary power to operate the same, than to any inherent defects in the principle.

The wing machine also lends itself readily to simplicity of construction, and combines in itself the element of stability to a marked degree, if designed in accordance with the best known methods employed in the construction of light machinery; and although it is necessary to reduce or keep down all superfluous weight, it, on the other hand, admits a most reasonable amount of weight to be used without detriment to the required margin of safety.

How I arrive at the conclusion of the possible practicability of aviation, and am confident of ultimate success, is best expressed by the following statement of experiments conducted over a period of several years, and the deductions from the same; which I think will be found to be of a nature calculated to give considerable cause for satisfaction and encouragement

I have always held the belief that the future would bring the question of aerostation to the front, and that it would take rank as belonging to the recognised mechanical sciences, but just how this was to be accomplished was not so clear, seeing the almost insurmountable difficulties by which the science was beset; and I must state that the experiments, as first conducted, were undertaken more as means of recreation than with the idea of any ultimate benefit either personal or to the cause of aerial dynamics.

It was after a thorough perusal of Petigrew's Animal Locomotion, a book which I earnestly recommend to all students of aviation, that I recognised the possibility of surmounting most, if not all the difficulties of the situation, and to this publication is due, in a great measure, the credit of teaching me the first principles of aerial navigation.

The first experiments with wings was such as were intended to show what weight, if any, could be raised by the vertical depression of artificial wings, and for this purpose I used a wing, the framework of which was of straight-grained ash, the main rib being tapered from the root to the extremity; and from the main rib were carried radiating stays, also of ash, and tapering to the outer edge, the whole being covered with common calico. The wing had an arm or lever projecting beyond the root by which it could be manipulated, and the various weights I was wishful to raise were suspended at a point directly below the joint or fulcrum over which the wing worked.

The first experiments were conducted in still air, and were satisfactory in proving that very considerable weight can be raised by the depression of artificial wings; in fact the load that can be elevated is approximate to the power and the resistance. In this case I raised as much as seven pounds to the square foot, at which the wing broke. The breakage, however, was due to the unsatisfactory manner in which the radiating stays were attached to the main rib. I also found that during the upstroke a very considerable forward movement was given to the wing; this I attribute to the fact that in this stroke the wing impinges on the air with a convex surface, and so wedges itself forward. The angle or curve of this wing I estimate at about 20 degrees, but it was in this respect faulty, in that it was too rigid, and at the recovery of the stroke, the action was very laboured and clumsy.

Digitized by Google

This experiment was afterwards conducted in the open, in a moderate breeze, with a wing much more flexible, and answered well with a weight of 3 lbs. to the square foot. The feathering action at the termination of each stroke was perfect, but the same wing was practically useless when the load was increased to 5 lbs. clearly proving that the degree of strength and flexibility must be proportionate to the load. Another wing, stronger but still flexible and capable of raising 7 lbs. to the square foot, also in a strong breeze, had a splendid feathering recovery, without any dead point at the end of either stroke, the current of air impinging on the under or concave surface, practically elevating the wing without any assistance whatever—in fact the wing had to be steadied during the up-stroke.

These experiments, interesting of themselves, were undertaken for the purpose of my own satisfaction, and to enable me to feel sure of my data through personal observation, and my impression is that, given good material and construction, wings may be produced capable of registering on the fulcrum the equivalent of 14 lbs. to the square foot. I should also remark that the best results were obtained by the use of wings whose length and width were as 3 to 1, and with a curvature of about 25 degrees.

The continuation of these experiments, I am bound to add, gave an immensity of trouble, and were conducted under great and exceptional difficulty, so much so that I was almost despairing of finding any practical benefit; and although I had the certain knowledge of the capability of the wings to raise very considerable weight when manipulated by hand, it was impossible to obtain the slightest elevation when I endeavoured to make the vessel self-supporting, no matter the amount of power employed to elevate and depress the wings. This certainly was not very encouraging; but as there is no effect without a cause, it became at once important that the cause should be discovered, and it is in this respect I claim to have made satisfactory progress.

It is well known that action and re-action are equal and opposite, and that force expends itself in the plane of least resistance; consequently it is obvious that whatever power was employed to raise the lever of the wings (in the first-mentioned experiment) reacted in a downward direction, and finding a ground support was thus enabled to elevate the weight, he wing in this case representing an ordinary lever where the power and the resistance were both on the fulcrum in an upward direction, the resistance of the air to the down stroke of the wing, and the support obtained from the earth for the reaction of the power being the primary cause of the seeming elevating power of the wings, but when the power necessary to operate the wings was contained in the vessel or weight to be elevated, quite another action was set up, the force escaping in the path of least resistance, and becoming in fact non-effective, simply because the vessel offered a less resistance to downward motion, than the levers of the wings to an upward one. Consequently it may be said that immediately the elevating power was sufficient to raise the vessel, a counteracting influence was at the same time established, by reason that the necessary support to receive the reaction was withdrawn, and the whole arrangement was in a state of collapse, and to this action must be ascribed the great number of failures that have overtaken all attempts to solve the problem of aerial navigation by the flapping of wings.

After it had been ascertained to what might justly be ascribed the cause of successive failures, viz., the want of a foundation on the air sufficiently stable to receive the reaction of the power, it became a seemingly easy matter to devise a remedy, the one thing needful being a foundation on the air as contradistinguished from the vessel, and, as in all other forms of locomotion, obtain a support on which the travelling surfaces could successfully operate. This principle is at the root of all that is best in aviation, in fact is the main principle involved, and so confident was I, that without putting the matter to further experiment, I forthwith patented an invention, No. 10239, 95, in which it was attempted to cover this action, and although the principle is all right it was afterwards found that the construction was all wrong I had fallen into the same error that has been fatal to so many inventions of this class; in fact, into the same error that it was designed to overcome. The mistake was pardonable, seeing that I had taken the opinion of several experts on the matter, men exceptionally well versed in mechanical science, and all agreed that the plan of aviation, as outlined to them, was most feasible, and would no doubt be practical.

A reference to Fig. 3 of the specification of the before-mentioned invention, showing an end view of the proposed machine, will best explain where the mistake lay. The machine was designed with several upright columns, each column carrying two pairs of wings working at different elevations; the higher wings were in-

tended to operate as elevators and sustainers, while the lower wings were provided as a means of receiving and distributing the reaction of the power necessary to operate the elevator wings. The power was to be applied between two pistons working in each end of a common cylinder, and the two pistons, coupled each to a higher and a lower wing, so that when the pistons were forced apart, it was estimated that the resistance the lower piston would encounter by forcing the lower wing down on the air would form a support sufficient to enable the higher piston to operate the lever of the elevator wing, and so produce on the hinged joint or fulcrum of the higher wing the full effect of both the power and the resistance in an upward direction. As before mentioned, this theory is in perfect accord with the requirements of both natural and artificial flight, and a foundation must be found on the air before the power can be successfully applied to the wing. Where the fatal error was made, as proved by subsequent experiment, was in pivoting the lower wings to the machine, thus transferring the onus of support from the air to the vessel and from thence to earth, as it is obvious that if the vessel cannot support itself in the air it is an impossibility for it to support the reaction of the power intended for its elevation.

After the disappointment experienced relative to the unforseen action of the wings, I had the lower wings disconnected and substituted an aeroplane which was free to move in a vertical direction on the upright column, the aeroplane to receive and distribute on the air the force acting on the lower piston, while, at the same time the aeroplane by virtue of the curve presented to the horizon, acted as a true kite and assisted to support the lower piston, thus working up the air into a comparative solid foundation. In connection with this aeroplane, it is most important that in the sliding motion on the column friction shall be reduced to a minimum, for which purpose the very best bearings are required, as an excess of friction would be equal to fastening the aeroplane to the column, in which case the power would be non-effective.

This combination of wings with aeroplanes, used as a means of support, gave the first really encouraging sign toward a solution of this problem. By their use I was enabled to obtain for the first time a direct elevating power, and of sufficient intensity to convince me that in this direction lay the main principle of aviation, namely, converting the atmosphere into a basis of support sufficiently stable to receive the reaction of the power, or to form an independent foundation or foothold on the air on which the power could work. Further experiments in this direction fully bore out the expectations already formed, and the question naturally resolved itself into a mechanical and constructional problem, in which I have received great assistance from a friend, Mr. W. Litchfield, who has, since taking part in the experiments, and being convinced of the practicability of aviation, devoted himself unreservedly to the furtherance of this science, and I must say that to the energy displayed by him I am indebted in a great measure to the present encouraging outlook.

I do not at present propose to deal with the construction of the wings, and aeroplanes, except in so far that I find it preferable that both shall be flexible from the root to the extremity, and the degree of strength and flexibility to be proportionate to the load, and that the angle presented by the under or concave surface should be about 25 degrees, that is, when the wings are in their normal condition, and that the degree of flexibility required is such that during the down or effective stroke of the wings, the posterior or thin edge of the wing should not rise above, but be on a level, or, indeed, slightly lower than the front edge. The wing is thus able to compress the maximum quantity of air with the minimum of slip. This slip has been magnified by some investigators into an almost insurmountable obstacle, but it really is of so little consequence that it need not be taken into consideration, the mistake arising through the power escaping in the plane of least resistance.

The aeroplane should be constructed with the same degree of flexibility as the wings, and be arranged to slide vertically on the columns, thus severing all direct connection with the machine, and form true kites, whose centre of pressure from the resultant forces of the wind currents acting on the under or concave surface and the direct action of the actuating fluid is in an upward direction. The resistance thus found to the down stroke of the lower piston practically converts the same into what may be termed an independent and most suitable foundation, and one that can be fully and beneficially utilized on which to raise and sustain the whole machine.

Having now explained to the best of my ability the positive action of the wings and aeroplanes during the down stroke of the same, there still remains a most important though negative action, and one which has a directly economic bearing on the subject. I refer now to the up stroke or recovery of the wings and aeroplanes to their raised position, for on this

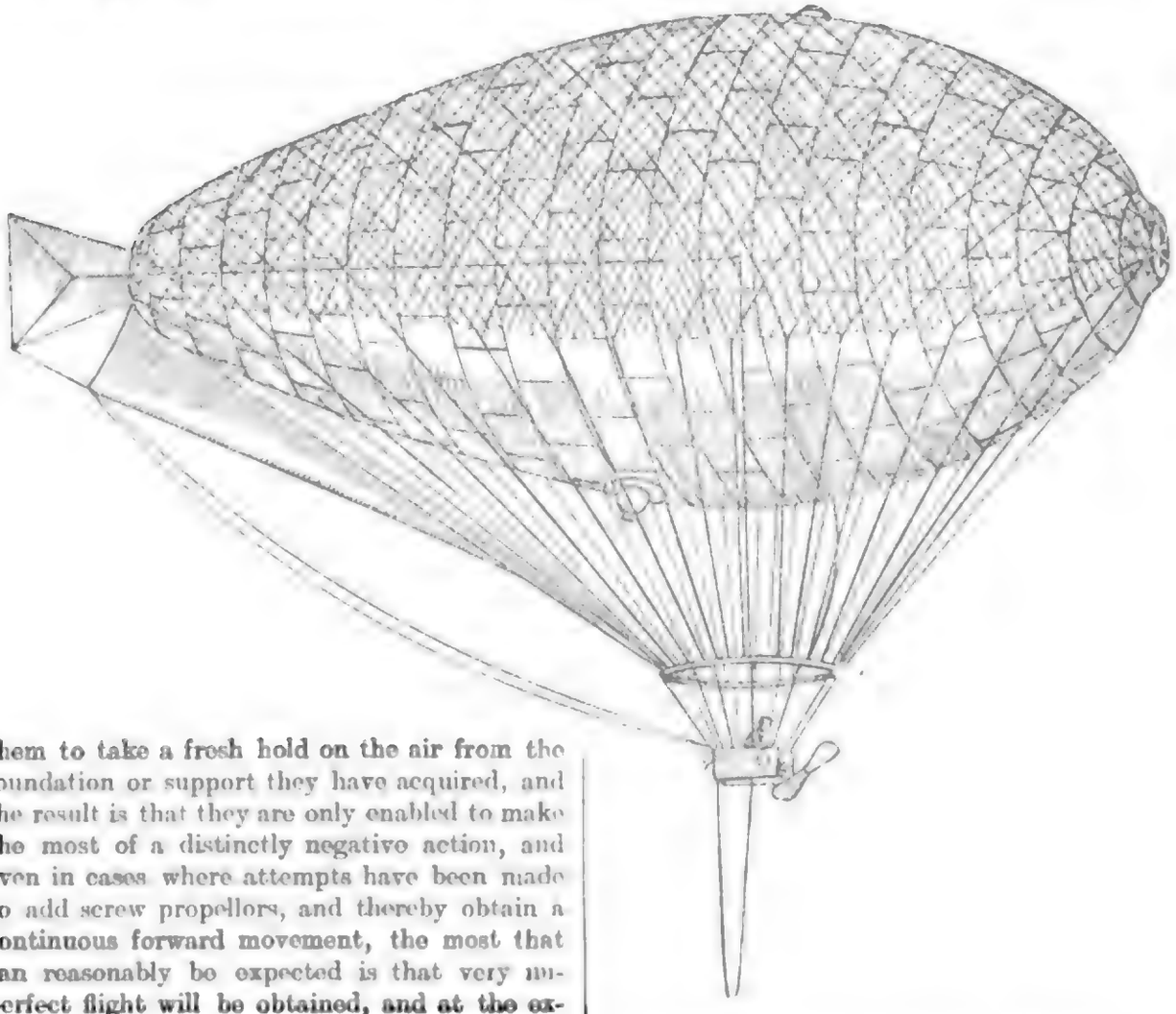
Digitized by Google

action depends the entire effort required for propulsion, and on which gravitation exercises a most useful and important bearing. In fact, it may be stated that after the initial velocity has been acquired by the reciprocating action of the two pistons, propulsion may be effected by the force of gravitation alone.

To leave for a moment my own experiments, it has been conclusively proved by Chanute, Pilcher, Lilienthal, and others, that weight or gravitation acting on inclined planes gives a strong forward movement if the centre of pressure be properly adjusted, and that this is so needs no confirmation from me. Still, at the same time, in their experiments in gliding or soaring flight, no provision is made to enable them to take a fresh hold on the air from the foundation or support they have acquired, and the result is that they are only enabled to make the most of a distinctly negative action, and even in cases where attempts have been made to add screw propellors, and thereby obtain a continuous forward movement, the most that can reasonably be expected is that very imperfect flight will be obtained, and at the expense of a ruinous expenditure of power, because to be effective the power must entirely counteract gravity, and thereby minimise to a great extent the good effects that gravitation was bestowing; and, even granting that sufficient elevation could be obtained to allow soaring or sailing flight to be attempted, the very considerable drag that would result if the propellors were out of action, would present a most serious obstacle to soaring flight.

What I contend is required is that there shall be a reciprocating action between the power and the weight of the machine, the power during the down or positive stroke of the wings (through the support afforded by the aeroplanes and lower wings) elevating or sustaining the machine, and that in the up stroke, which is effected mainly by gravitation, but at the same time controlled by the motive power the propulsive force is generated, the two forces mutually assisting each other, and the effect of the combined forces is such that the same efficiency can be obtained that is developed by any stationary or earth-supported machine.

J. MARSHALL.



Gaudron's Navigable Balloon.

Mons. Auguste Gaudron made an ascent on May 30th from the Alexandra Palace in his new balloon, of which we give a sketch. The vessel was inflated with coal gas for the experiment, and a 2-horse power petroleum motor was pro-

vided by Messrs. Hunter, of Lewisham. The following account is from the "Daily News":—

No one who has travelled in the air could quite expect Mr. Auguste E. Gaudron, in his newly-constructed "navigable balloon," to do more yesterday than "endeavour to steer it round the district, and return to the Palace Grounds." Had he succeeded, the exploit would, indeed, have been "the event of the season." But, even if nothing else had intervened, the driving of a gas balloon agninst, or even far out of course of, a wind blowing at twelve miles an hour, was practically hopeless. The balloon was a new one, made in the shape of a porpoise, with the head rounded off and the tail represented by two small sails. It is 60 feet long, 28 feet largest diameter, and, when fully inflated, contains 25,000 feet of gas. The basket car, two feet wide and about five feet long, was furnished yesterday with a petrol engine to drive a propeller of two blades each about four feet long and eighteen inches of greatest width, made of aluminium. By means of the propeller, driven by the petroleum, it was hoped, had the air moved at a less rate than six miles an hour, to turn the balloon out of the course of the prevailing current, if not to return to the starting place. Thousands of the Whitsuntide visitors gathered around the area whence the curious machine at half-past five soared aloft. Mr. Gaudron was the only passenger. It mounted some fifty feet above the heads and upturned faces of the people. Driven by a westerly wind, it sailed away due east in the heavy and moist atmosphere, and seemed likely at first to make a sudden descent. By emptying part of the little ballast which he carried in addition to the 140 lb. weight of the apparatus, the aeronaut was able to rise to about a thousand feet, and at that level was carried towards Epping Forest. The propeller made several erratic revolutions before the petroleum, ignited by electricity, brought full power into play. After that the blades revolved rapidly and more constantly, but without producing any perceptible effect except of turning the balloon sometimes sideways and sometimes end-on to the wind. Even this might be due to the gyration which occurs with an ordinary balloon. In about ten minutes it faded out of sight. The flight was watched with some interest by Capt. Baden-Powell, Secretary of the Aeronautical Society; Mr. T. Wright, and others concerned in aeronautical science and pursuits; and by Mr. Barth, Manager of the Alexandra Palace. The balloon, we have heard, eventually descended at Chigwell.

The International Aeronautical Conference at Strasburg.

From "Science."

The meeting of the International Aeronautical Committee appointed by the Paris Meteorological Conference of 1896 was noteworthy in two respects. First, it marked the beginning of a new era in meteorological investigation, as shown by an organized effort to cut loose from observatories on the earth and to study the conditions of the free air; and, second, by the assembling at Strasburg of French and Germans. Political questions were held to be subservient to the conquest of the high atmosphere and the extension of the common realm of science. Official and private hospitality was abundant, and the utmost good fellowship prevailed among the members of the Committee and the other meteorologists, physicists and aeronauts who were presnt by invitation. It was regretted, although hardly a surprise, that there was no one from Great Britain, where, since Glaisher's remarkable balloon ascensions, little has been done to explore the free air. The following named members of the Committee were in attendance: Professor Hergesell, the President, of Strasburg; MM. de Fonvielle, the Secretary, Cailletet and Besancon, of Paris; Drs. Assmann and Berson, of Berlin; Professor Erk, of Munich; General-Major Rykatcheff and Colonel Kowanko, of St. Petersburg; Mr. Rotch, of Boston, United States.

The methods discussed for obtaining observations in the free air were balloons with aeronauts; ballons-sondes, or unmanned balloons to carry self-recording instruments to the height of ten miles or more; and, for observations within a mile or two of the earth, the captive kite-balloon, and kites with self-recording instruments. Aside from technical details, the most important decisions concerning balloons related to the measurements of their height and of the air temperature around them. Although, for the determination of height, from observations in the balloon, the mercurial barometer must be consdered as the standard, yet its indications are only accurate when the balloon has no vertical velocity. If aneroids are used they should be compared frequently with the standard and, so far as possible, under actual conditions. It was decided that for the calculation of height the barometric observations should be reduced every-

Digitized by Google

where by the same method, whatever that might be ultimately. M. Cailletet described his apparatus for photographing automatically, at fixed intervals of time, a barometer in the balloon and the ground vertically below, so that the barometric heights can be calculated, and from a map the true heights and the route of the balloon may be determined. This apparatus was recommended for use with the both manned and unmanned balloons. On account of the rapid changes of temperature, it was recognized that very sensitive thermometers must be employed in ballons-sondes, and that their artificial ventilation is essential. M. Cailletet exhibited a thermometer having a spiral silver tube for its bulb soldered to a glass tube, both being filled with the liquid toluene. This thermometer is extremely sensitive. M. Teisserenc de Bort showed a very sensitive self-recording thermometer, which is at the same time almost insensible to shocks. It is composed of a blade of German silver set in a frame of invariable steel, and can be ventilated in a ballon-sonde by a fan turned by a weight attached to a long wire. For the determination of the temperature of the air around manned balloons the proper instrument to employ is Assmann's aspiration thermometer, hung at least 5 feet outside the basket, but simultaneous comparisons with the sling thermometer were advised. The self-recording instruments carried in manned and unmanned balloons should be verified in pneumatic and refrigerating cabinets under such changes of pressure and temperature as might occur in the atmosphere.

Drs. Hergesell and Berson urged the importance of simultaneous balloon ascents in the different countries when there was a barometric depression over the European continent. From a meteorological standpoint the manned ascents have an importance which the ballons-sondes do not possess, because the temperature of the highest atmosphere has no influence on the meteorological elements near the surface of the earth. M. de Fonvielle, however, called attention to the interest which thermometric measurements at a very high altitude would offer for the determination of the temperature of planetary space. These measures might enable us to choose between the kinetic theory of gases, which assumes the temperature of 273 degs. Centigrade below zero, and Fourier's hypothesis that the temperature of space is near that of the minima observed in the polar regions of the earth.

It was agreed that the fifth international ascent of ballons-sondes should take place early in June, and manned or unmanned ascents were promised in Austria, Belgium, and Italy, in addition to those in Germany, France and Russia, which countries had already co-operated. On the day designated, observations at the mountain stations, as well as with kites and captive balloons, will serve for the simultaneous study of the lower air.

Mr. Rotch read a report, which he had been asked to prepare, on the use of kites for meteorological observations, based on the experiments carried on at Blue Hill Observatory for several years past. The advantages which kites have over balloons up to a height of at least 10,000 feet, whenever there is wind, were pointed out. It was reported that, besides their use in the United States, kites were being employed to obtain meteorological records at St. Petersburg and near Paris. M. Tacchini proposes to try them on Mounts Cimone and Etna, and Professor Hann hopes to obtain data in this way above the Sonnblick, the highest permanently occupied observatory in Europe. The Conference recommended kites as being of great value to meteorology, and desired that they should be used at the chief observatories, together with the kite balloon (described hereafter) for continuous observations. The Committee was enlarged by the addition of the following persons: M. Teisserenc de Bort and Prince Roland Bonaparte, of Paris; Professor Hildebrandsson, of Upsala; Professor Pernter and Lieutenant Hinterstoisser, of Vienna; Captain Moedebeck, of Strasburg, and Lieutenant von Siegsfeld, of Berlin. The next meeting will be at Paris in 1900.

During the Conference there were two trials of the kite-balloon—a captive balloon which, unlike the ordinary spherical one, is not driven down or carried away by strong winds. It is the invention of Lieutenants von Parseval and von Siegsfeld, of the German army, where it is used for reconnoitring; but the smaller Strasburg balloon, constructed by Mr. Reidinger, of Augsburg, for Professor Hergesell and Captain Moedebeck, is the first to lift self-recording meteorological instruments. It consists essentially of a cylinder of varnished linen, having a volume of 7,770 cubic feet, so attached to the cable that its upper end is inclined towards the wind, which thus tends to raise the balloon. The cylindrical form is preserved, notwithstanding leakage of gas, by admitting wind into an auxiliary envelope at the rear end, which also serves as a rudder, stability about the axis being secured by lateral wings. The instruments are contained in a basket, with open ends, hung far

Digitized by Google

below the balloon. The azimuth, angular altitude and traction of the cable are recorded continuously by an ingenious dynamometer. In spite of unfavourable weather and gas of insufficient lifting power, the experiments were fairly successful, and previously the balloon had been maintained during several days above the city.

The Committee also witnessed an ascent of the ballon-sonde "Langenburg," carrying self-recording instruments. This silk balloon, when inflated with 14,000 cubic feet of coal gas, had an initial lifting force of 440 pounds in excess of its load. Owing to a premature start, the ballast was left behind, and the sudden plunge upward not only emptied some of the gas, but stopped the clock movements of the thermographs. The ascent was made in the late afternoon, and the balloon, which soon disappeared in the clouds, was found the next day about sixty miles south-east of Strasburg, having risen more than six miles, as was determined from its barometric record.

A. LAWRENCE ROTCH.

Wise's Photographic Kite.

We have received from Lieut H. D. Wise, 9th United States Infantry, a number of photographs of his apparatus, and photographs taken by it. These should be of especial interest just at present, when we hear that kites will probably be employed during the Spanish-American war. The inventor, writing from Madison Barracks, New York, gives the following description of the photographs:—"No. 1 represents the apparatus for supporting and operating the camera. As you will see it is universal pointing, and the shutter is operated by clockwork set for a given time. I also have an electrical apparatus for accomplishing this purpose. The field kite contains eight 'Wise-Eddy folding kites,' 2 nine foot, 2 eight foot, 2 seven foot, and 2 six foot; 6,000 feet of cord, assorted size; one field windlass, rings, pulley, etc.; sixteen regulation signal flags with code staff; one Wise Universal Pointing Camera and support; one Wise automatic operator for camera; one



WISE'S KITE PHOTOGRAPHIC APPARATUS.

Digitized by Google

camera, 4 by 5, and one developing and printing kit. The compactness of it you will see by the picture; two men can carry it with ease. All of my experiments recently with signalling have been most gratifying. On one occasion I signalled a distance of twelve miles by the use of lanterns and calcium lights. . . . No. 8 is what I call a map picture, and represents a portion of this post. Its value, of course, would be in connection with topographical mapping. All these pictures are taken under service conditions, where the operators are not seen, and not exposed to possible fire. You can readily see the value for military work."



MAP PICTURE FROM KITE.

A New Form of Kite or Aeroplane.

The photographs show side and end views of a kite of my own invention. I am now constructing a full-sized machine designed to carry one man, embodying the principle of this kite—which is to counteract and utilize the variable velocity and direction of air currents.

It consists of four concave-convex wings, longer from front to back than wide from tip to tip. The axis is hollow and spindle-shaped, with the larger end in front; the lower side of the latter end is cut away; in this opening the operator is seated.

This hollow axis, so far as I know, is a new and important factor in a flying machine, and may be the turning-point to success, as it will work on other designs than this. It prevents the machine falling forward on account of the opening forming an angle with the wings, and the latter prevents it falling sidewise.

The wings are rigid in front and flexible in the rear. A bicycle wheel is beneath to run on the ground. The frame is of steel tubing and bamboo covered with sheeting, and spreads from 190 to 210 square feet of sustaining surface, or about one square foot to every pound of weight to be lifted and carried. When open it is from 12 to 15 feet long and 8 to 10 feet wide and high. When closed it presents a bundle similar to an umbrella 8 to 10 feet long. Its weight is from 25 to 35 lbs.

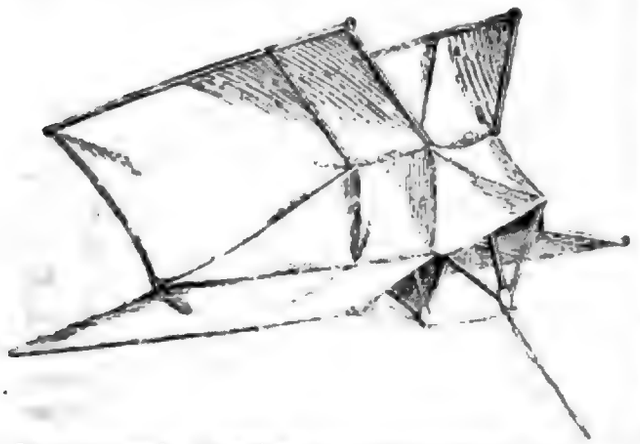
Through many experiments it is found that this machine safely and evenly rides or sails through the air without deviating to the right or left unless so directed by the operator, who by bearing his weight on one side can steer to that side. It will go up or down, always with

Digitized by Google

the right side up, no matter how the wind blows. It sails at a flat angle with the horizon, and often advances against the wind as though pushed by some unseen force.

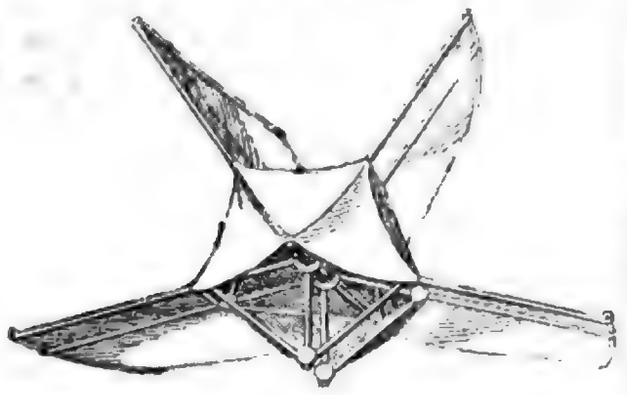
The lifting power is all that can be desired, and corresponds well with the accepted tables of wind pressure on concave surfaces. It will lift from 10 to 20 lbs. for every pound of drift or resistance to advance.

It will be seen that an operator weighing 165 lbs., to lift himself and machine of 35 lbs., will have to develop from 10 to 20 lbs. of propulsive



force or push, in order to overcome the wind, and to continue advancing. This power will not be continuous on the part of the operator, for we expect to extract the most of it, and at times all of it, from the energy of the air when the wind is blowing, in which case a machine can be made to sail against the wind without effort, save that of balancing, which is reduced to a minimum, and is automatic in this construction.

The maximum power will be required to get a start when there is no wind, and I think by



a mode of operation which I am not at liberty, at present, to make public — sufficient power can be developed to advance in the air, and when the wind is blowing the power required will be reduced to the minimum.

It is conceded by many students of aeronautics that the wind often has an upward trend, and that it does not flow in parallel or straight lines, but in swirls or eddies—miniature cyclones, as it were—with their axes vertical, horizontal, or diagonal across the path of its motion, as is shown by smoke as it issues from a chimney, or dust, leaves, and debris as they are picked up and carried away by the wind. What smoke, dust, leaves, etc., in the air does, the air does likewise, and vice versa.

These "internal forces" of the air seem to account for the sudden and momentary pitchings up and down and sidewise of a rigid pair of wings held in the wind, resulting in the discomfiture of the experimenter.

Numerous experiments indicate the near solution of this interesting and difficult problem, and that, too, without the intervention of a motor.

We believe it to be simply a matter of constructing and and adapting common material to the strength of the operator and to the conditions of the amosphere in which it is to operate.

The machine must be automatic in equilibrium, must be foldable into a small space, so as to be used as is the bicycle to-day. We must be able to start up and come down under all conditions, go when and where we please at the rate of 20 to 60 miles an hour. and effect a safe and sure landing, the only requisite being an open space free from obstruction.

CHAS. ZIMMERMAN, M.D.

Frederick, Md., U.S A., March 1, 1898.

Scientific Balloon Ascents.

In execution of a resolution of the International Congress on Scientific Balloon Navigation, which was held at Strasburg in 1897, fourteen manned balloons and eight which were not manned were simultaneously set afloat at Vienna, Paris, Berlin, St. Petersburg, Brussels, Munich, and Strasburg at eight o'clock on the morning of June 8th.

Aeronautical stations in the respective countries were asked to observe the movements of the balloons. The results of the observations will be sent to Professor Hergesell, of Strasburg, President of the International Commission.

Three ballons were sent up from La Villette, Paris. The first, measuring only 1,200 cubic feet, was sent up at 2.30 a.m. for the purpose of registering the temperature of the air before sunrise. This operation had but few spectators, whereas the two later ascents attracted

Digitized by Google

about 500 persons belonging to scientific, aeronautic, and Press circles, including the Prince of Monaco and a large number of ladies, as also several members of the United States Legation, now naturally interested in ballooning.

The second balloon, measuring 14,000 cubic feet, was sent up at 9 o'clock. The Prince of Monaco cut the rope attaching it to the ground. The car of the balloon contained various instruments, including a baro-thermometer by Richard, another by M. Teisserenc de Bort, director of the Trappes Observatory, a registering actinometer by M. Viollet, of the Institute, and an automatic photographic camera by M. Cailletet, taking at five minute intervals 20 views of the surface at the nadir of the balloon, whether land, sea, or cloud. Nothing was seen of the balloon from the top of the Tour St. Jacques, whence observations were to have been taken by M. Jaubert, director of the municipal meteorological department, and a like disappointment awaited M. Secretan on the top of the Eiffel Tower. Persons who had assembled in the grounds of the gas company watched the balloon, but only for eight minutes. It then disappeared in the clouds which were passing at an altitude of 4,000 or 5,000 ft. This shows a mean velocity of somewhat less than 10ft. per second, and indicates that the French balloon could not reach an altitude of 45,000 ft. as on former occasions, but would hardly reach 30,000 ft., owing to the increased weight of scientific instruments. When it passed out of sight it was travelling in the direction of the North Sea, but it is expected that the strong westerly wind always blowing in high altitudes above the loftiest mountains will send it eastwards. At 9.30 a slight rain set in and continued for some hours. The wind was very moderate and varied in direction.

The ascent of the Balachoff, which was sent up with an aeronaut and with M. Hermite, was a very easy and picturesque one. The car was full of scientific apparatus, so that the occupants had scanty elbow room. There were two large baskets containing Viollet's registering actinometers in order to determine by accurate measurements the intensity of solar radiation..

The day was unfavourable for the balloons. Berlin, Munich, Vienna, Strasburg, Warsaw, Brussels, and Rome may perhaps have had better luck for their simultaneous ascents. The aerial district thus constituted covers about 1,200 miles in longitude and as many in latitude, or 12 to 14 times the extent of England and Wales. This is the most extensive scientific operation on record, and the non-participation of England is much regretted, especially as Glaisher was one of the creators of scientific aeronautics. The collection and discussion of the observations will, of course, take some little time.

Particulars of the three balloon ascents are now known, though the scientific results have yet to be ascertained. The Balachoff, sent up from Paris at 11 a.m., came down at 1.30 p.m., after experiencing a thunderstorm, at Magny, 40 miles to the north-west. The clouds were so heavy that it was impossible to mount higher than 7,000 ft. The landing was effected without damage to a single instrument. The smaller sounding balloon, sent up at 2.30 a.m. was discovered at 10 at Verpilliere, near Montdidier, about 50 miles north of Paris. The larger sounding balloon, provided with the automatic photographic camera, was seen at 6 p.m. at Guelder, in Westphalia, on the Dutch frontier, about 300 miles N.N.E. of Paris. All the instruments have been found and are in good order, but some of the plates have been lost, as the people opened some of the boxes. The barometric pressure will take a little time to calculate, but it is expected to be ready for the next meeting of the Academy of Sciences.

At Vienna five balloons ascended. The first was the Breitensee, with only Lieutenant Pakeny in the car. It rose at six o'clock from the courtyard of the arsenal, so slowly that it was feared the car would be smashed on the roof of the building, but it just escaped, and the balloon disappeared in the direction of Hungary. The second rose at seven, went straight up three hundred feet, and then remained immovable for a quarter of an hour, when it disappeared in the clouds in the same direction. At a quarter to nine the balloon Falke was released. It was without a car and was filled with hydrogen. Attached to it was a warning not to approach it with either pipe or cigar, and a reward of 25 florins was offered to anyone who might bring it back. An iron anchor was attached to the balloon, and it was assumed that it would remain in the air three or four days, and that the instruments in it would record temperatures, etc. Instead of that it was not ninety feet high when it burst, turned upside down, and fell with an enormous crash upon the old fortification walls. At nine a new balloon, the Austria, with valuable apparatus on board ascended with First-Lieutenant Dr. Kosminsky and Lieutenant Koziol. It fell to the ground after it had travelled a very little way. Another balloon ascended from the exhibition grounds with First-Lieutenant Hinterstoisser and Professor Tuma. All the aero-

nautical stations in Austria have instructions to watch for the balloons and telegraph news of them.

The Belgian balloon ascended at 8.43 a.m., carrying registering instruments for the study of atmospheric pressure and electricity and temperature, and photographic apparatus for measuring the height reached by the balloon. It is hoped it will reach an altitude of 6,000 metres (nearly four miles).

Obituary.

MR. H. PERIGAL.

We much regret to have to record the death, on June 6th, of one of our oldest members, Mr. Henry Perigal, at the advanced age of 97 years. He was elected in February, 1866, within a month of the foundation of the Society, and in point of seniority was second only to Mr. Glaisher. Mr. Perigal was for some time a clerk in the Privy Council Office, and afterwards in the old Victualling Office. Subsequently he joined the firm of Messrs. Henry Tudor and Son, of Threadneedle Street. He was the author of various works on astronomy, bicycloidal and other curves, kinematics and the laws of motion, probable mode of constructing the pyramids, etc. He was a Fellow of the Royal Astronomical, Royal Microscopical, and Royal Meteorological Societies, of which latter he was Treasurer, as well as a member of several other scientific associations, and until within two years of his death was constant in his attendance at their meetings.

DR. HUREAU DE VILLENEUVE,

another well-known worker in the field of theoretical aeronautics, has also passed away. M. Abel Hureau de Villeneuve was elected a complimentary member of our Aeronautical Society so long ago as 1868. He founded and edited the well-known French periodical "L'Aeronaute," which has continued its monthly issues for over thirty-one years, and contributed many interesting articles to its pages. In 1878 he was elected President of the "Societe Francaise de Navigation Aerienne" for the year, and has for long been General Secretary to it. He died suddenly in Paris on June 2nd in his 65th year.

NOTES.

Across Africa by Balloon.—Three French officers are about to endeavour to cross the Sahara Desert in a balloon. They will start from the Gulf of Gabes, and land, if all goes well, in the Niger Territory a month later. The balloon will have a cubic capacity of 13,000 metres, and will be able to remain in the air for from forty to sixty days. All possible precautions are being taken to assure the success of the enterprise. A start will be made by a north or north-east wind, which should take the travellers to Rhadames, whence they will be blown by the steady and reliable north-north-east desert winds towards the Niger, or even the Atlantic if so desired. The Leo Dex will drag behind it a steel wire guide rope one thousand two hundred yards long, and should any natives be so ill-advised as to lay hold thereof, the action of a powerful Rumkorff apparatus in the car will induce them to let go again. Another original device is that the ballast of the balloon will be composed of leaden bottles painted bright red and filled with liquid. Should an accident oblige the travellers to descend in the desert the red bottles thrown out from time to time will serve to indicate their route, besides, perhaps, enabling them to quench their thirst. The officers who are undertaking this journey, which reminds one of Jules Verne's book "Five Weeks in a Balloon," are Naval Lieutenant Hourst, the explorer M. Leo Dex, "aeronaut pilot" of the Ministry of War; and Captain Dibos, of the Engineers The Paris Municipal Council has just voted 15,000 fr. for a public trial trip of the Leo Dex to be made from Paris.

Ader's Flying Machine. — The French Minister of War is encouraging the flying machine, or "Avion," of M. Ader for military purposes, to wit, as aerial scouts for discovering the position of the enemy or their manœuvres, and as aerial destroyers destined to throw bombs down on troops or cities, and even fight other aerial destroyers in the air. Trials of the Avion were made recently at the camp of Satory, but though successful at first, an accident put an end to them. They are, however, considered satisfactory. The Avion is a true flying machine, with large wings like those of a bat, made of silk on bamboo frames. They are worked by a steam-condensing engine of great power for its weight and size. The weight of the motor is about 7 lb. per horse power. The total weight of the Avion is about 1,100 lbs. The rest of the machinery is of

hollow steel, rigid and light. It is proposed to establish an Ecole d'Aviation Militaire, and already there is a Laboratory of Aviation in the Rue Jesmin, Paris. Apparently, then, we are about to see the flying machine at last.

KITES FOR METEOROLOGY.—The monthly meeting of the Royal Meteorological Society was held on Wednesday afternoon, the 15th inst., at the rooms of the Royal Astronomical Society, Burlington House, Mr. F. C. Bayard, LL.M., President, in the chair.

A paper by Mr. A. L. Rotch was read on "The Exploration of the Free Air by Means of Kites at Blue Hill Observatory, Mass, U.S.A." After giving a brief account of the use of kites for scientific purposes from 1749 to the present time, the author described the various forms of kites which have been employed at Blue Hill Observatory—viz., the Eddy or Malay tailless kite; the Hargrave cellular or box kite; and the Lamson aerocurve kite. The highest flight was on Oct. 15, 1897, when by means of four kites having a combined lifting surface of 150 square feet, the meteorograph at the end of 20,100 ft. of wire was raised vertically 11,080 ft. above the hill. About 200 records from kites have been obtained in the free air at heights from 100 ft. to 11,000 ft. in all kinds of weather. Mr. Rotch maintains that the kite can be made of the greatest importance for meteorological investigation. At the recent meeting of the International Aeronautical Committee at Strasburg it was recommended that all central observatories should employ kites as being of prime importance for the advancement of meteorological knowledge.

VARICLE'S BALLOON FOR KLONDIKE. — M. Antoine Varicle, of the French Geographical Society, has been a couple of weeks and more in America, preparatory to starting on a voyage to the Klondyke in his new balloon. This is to be steered by means of a sail and a rope, as in the trips made from Paris to Theneul and from Paris to Hamburg. The balloon is cylinder-shaped with the sail below, and it is furnished with electric lights and a search light, and will carry a weight of about 7,300 lb. When the apparatus for inflating the balloon with hydrogen is ready at Juneau, the start will be made, and the progress of M. Varicle and his companions will be made known by messages by carrier pigeons. If the trip is successful, M. Varicle will probably attempt a balloon voyage to Spitzbergen, and another across the Sahara.

M. Antoine Varicle, the inventor of the balloon who has been negotiating with the United States War Department with a view to using his invention in connection with the present hostilities, has gone to Washington with two of his associates to have a conference on the subject, a favourable answer having been received to the correspondence which has been going on since the arrival of the party in this city.

A PROJECTED SCIENTIFIC ASCENT.—An ascent is to be made on the 27th of July from Newbury with a definite scientific object. The aeronauts are the Rev. J. M. Bacon, whose success in India during the eclipse of the sun in January must be familiar to every astronomical reader, and Dr. Lachlan (late Fellow of Trinity College Cambridge), and their immediate object is to experiment in electrical tests and measurements, spectroscopy, visual and photographic; photometric determinations and actinism, the penetration of sounds, fog-signals, acoustic clouds, etc. . . . Messrs. Bacon and Lachlan will take up a thorough equipment of instruments, and, all being well, it is impossble to doubt, will secure results of enduring value to science.

GREAT HEIGHTS.—Men of science have, for various purposes, tried to get as far above the earth, and as far into it as possible. The current issue of a magazine furnishes an interesting chart of the greatest altitudes ever attained. The balloon takes the first place, having ascended in its highest flight to an altitude of 60,720 feet, while the highest flight of birds is 43,000 feet. The dwellings occupying the greatest altitude above the sea-level stand at 15,500 feet, and the highest railroad is 13,200 feet. Ballooning has not made much progress during the past hundred years. It has been employed in connection with the Hispano-American War; but for the most part the balloon has been regarded as an interesting and somewhat risky means of recreation.—"Yorkshire Herald."

KITE TELEPHONES IN THE NAVY (?).—Misleading notices have appeared in several papers (which ought to have known better), describing some experiments with "A Kite Telephone" in the Navy. An illustration, even, is given depicting a naval officer on the bridge of a large ship speaking into the telephone, which is apparently connected to an ordinary-looking kite floating overhead, whilst another string connects the kite to a three-masted ship in the distance.

The following is extracted from the article in question:—

"Some interesting experiments were recently made on H.M.S. Dauntless in the use of kite

telephones at sea, as shown in our illustration, the object being to supersede present rather obsolete and unsatisfactory methods of signalling at sea. The kite used was of the regulation sort, except that it was minus a tail. It was six feet long and three feet wide at the broadest point. In place of the tail the kite carried two lines, one of which was retained on board the Daring, the instructional torpedo boat destroyer, from which the experiments were conducted.

.

Following this experiment came one with a wire. The end of the wire which the kite bore away from the ship was dropped upon the deck of H.M.S. Dauntless, where it was secured by the electrician of the ship and attached to a telephone apparatus in waiting. The other end, which had remained aboard the Daring, was also attached to a telephone, and as soon as this task was completed, the two ships were in perfect communication. The kite remained suspended, secured by two lines, for more than four hours, during which time communication between the Daring and the Dauntless was uninterrupted."

We have the highest authority for stating: First, that there is no such ship as the "Dauntless" in the Navy. Second, that no experiments with telephones attached to kites have been made in the Navy. Third, that though kite experiments were conducted some time ago on the torpedo-boat destroyer Daring, the kites were not "of the regulation sort," but were of the Baden-Powell pattern, and were not "6 ft. long and 3 ft. wide."

Such inaccuracies are apt to mislead inventors and others, however ingenious the ideas suggested may be.

Foreign Aeronautical Periodicals.

L'AERONAUTE (Paris), *April:* "Felix Gratien," biographical notice. "Captive Balloons and Naval Warfare." Results of Ascent of Exploring Balloon. M. Variclé's Ascent, Paris to Tours. Kress' Captive Hélicoptère.

May: Circular to Exhibitors at the Exposition of 1900. History of Engines to Slacken Speed. Pilcher's Apparatus (from *Aeronautical Journal*).

June: Announcement of the Death of Dr. Hureau de Villeneuve, with portrait. Discourses by MM. Radau, E. Surcouf, P. Decanville, and Gustave de Borda.

LA FRANCE AERIENNE (Paris), 1—15 *April:* "Project of an Aeroplane with Benzine Motor," G. N. da Pra. "An Aerial Voyage," Raymond Bouchard.

15—30 *April:* Obituary Notice, "The Aeronaut Gratien."

1—15 *June:* "Schwarz Dirigible Balloon." "An Aerial Voyage," Raymond Bouchard (continued).

15—30 *June:* "About the Flight of Birds," M. Marey; extracts from his book, with comments. Obituary, M. Charles Labrousse; Abel Hureau de Villeneuve.

ZEITSCHRIFT FUR LUFTSCHIFFAHRT. *March:* "A Universal Kite with Rotary Sustaining Wings," W. Kauros. "Repression and Compression," E. Jacob. Blue Hill Kites.

April—May: "Observations of Wind Currents at Different Heights," Colonel Pomortsef, with numerous statistics. "Horizontal Flight," K. Lorenz. "The Development of Gas Balloons," Platte. "Kress's Flying Experiments."

L'AERONAUTA. *February—May:* "The Story of Aeronautics—P. Cordenons," E. Vialardi. "Aeronave Giam Pietro" (illustrated), looks fanciful. "Chanute's Experiments in Gliding Flight" (illustrated). "Dirigible Parachute of Conte Carelli" (illustrated). "Construction of Balloons." "Zanrossi's Wing Machine" (illustrated). "Ascent of the Duke of the Abbruzzi.' Notes.

ILLUSTIRTE AERONAUTISCHE MITTHEILUNGEN, No. 2. *April:* "The Aeronautical Troop of the First French Republic." "Motors for Aeronautical Purposes," Arnold Samuelson. "The Use of Kites for Lifting Men" (illustrated), Baden-Powell. "Andreé's Polar Journey in Balloon," Dr. Nils Ekholm. "Experiments of Major Moore" (illustrated). Notes. Patents.

Notable Articles.

April

English Illustrated Magazine.—"The Long-Sought Flying Machine." A fully illustrated history of the subject, though mixing up wild ideas with careful experiments.

Pearson's Magazine.—"To France by Air." G. GRIFFITH. The recent balloon trip to France, with many photographs taken from the balloon.

April 2. *Graphic.*—"Military Ballooning in Germany." (Illustrated.)

2. *Golden Penny.*—"The Last Seen of Andrée." (Illustrated.)

2. *Science Siftings.*—"Balloon Photography." Details of cameras, &c.

7. *Bristol Observer.*—"Mechanical Flight." (Illustrated.) Historical.

9. *Montreal Daily Star.*—"In Search of Andrée." The French balloon. Illustrated.

9. *The Cycle.*—"The Army Ballooning School, Aldershot." (Illustrated.)

15. *Public Opinion.*—"Flying Machines of the Past." From the *English Illustrated Magazine.*

16. *English Mechanic.*—"Aerial Navigation." A vague but arbitrary opinion.

20. *Chums.*—"To Those who Wish to Fly." Capt. Baden-Powell's flying machine. (Illustrated.)

28. *Nature.*—"Andrée's Balloon Expedition." (Illustrated.) Review of book.

30. *Morning Leader.*—"War Balloons."

May 4. *Evening Herald* (Syracuse, N.Y.).—"American Naval Balloons."

7. *Invention.*—"The Aluminium Balloon," and "Artificial Flight." Chanute's experiments.

7. *Golden Penny.*—"The Marvels of Kite Flying." (Illustrated.)

10. *Revue Technique* (Paris).—"Possibility of Long Balloon Voyages." Interesting and important article.

10. *Daily News.*—"Up in a Balloon." Account of Mishap at Earl's Court.

15. *Referee.*—Notes Referring to Flying Machines.

28. *Daily Mail.*—"Flying by Machinery." Davidson's proposals.

June *Cassell's Magazine.*—"When Men Fly."

4. *Science Siftings.*—"The Problem of Flight."

8. *Sketch.*—"Kite Flying." (Illustrated.)

10. *Church Family Newspaper.*—"Are We Learning to Fly?" Interview with Capt. Baden-Powell.

11. *Rambler.*—"Warfare in the Clouds." (Illustrated.)

21. *Globe.*—"When Ballooning was a Craze—Lunardi's Exploits."

21. *St. James's Gazette.*—"A New Flying Machine." Interview with Mr. G. Davidson.

25. *Daily Chronicle.*—"New Flying Machine." Davidson's.

Applications for Patents.

(*April, May, and June*, 1898.)

9,295. April 22. CHARLES RITZINGER, 48, Foley Street, London. **A New Method of Steering Aerostatic Machines.**

9,875. April 29. DANIEL EDWARD, 14, Upper Bedford Place, London. **Improvements in Flying Machines and in Screw Propellers, Fans, Blowers, and such like.**

10,162. May 4. JOHN GARDNER, 70, Market Street, Manchester. **Improvements in Means for Making Captive Aerial Ascents.**

11,914. May 25. EDWARD ZARSKI, London. **Improvements in and Relating to Navigable Balloons.**

11,986. May 26. EDWARD J. BARBER, Chancery Lane, London. **An Improved Balloon.**

13,700. June 20. GEORGE L. O. DAVIDSON, London. **Improvements in Flying Machines.**

13,769. June 21. MANUEL VASSEUR, New Broad Street, London. **Employment and Useful Application of the Electric Force to Aerostats and Balloons.**

14,179. June 27. JEAN XISTE DUSSEQUE, Queen Victoria Street, London. **Improved Navigable Balloon.**

14,377. June 29. HENRY VANDER WEYDE, Chancery Lane, London. **Improvements in Balloons.**

Patents Published.

From the *Illustrated Official Journal.*

25,716. November 14, 1896. **Flying Machines.** SIMMS, F. R., Amberley House, 12, Norfolk Street, Strand, London.

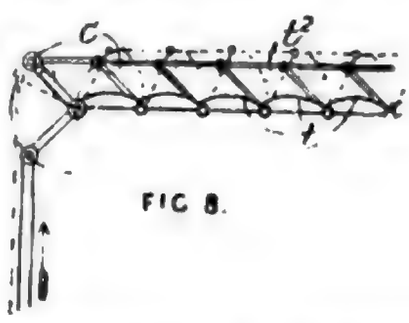
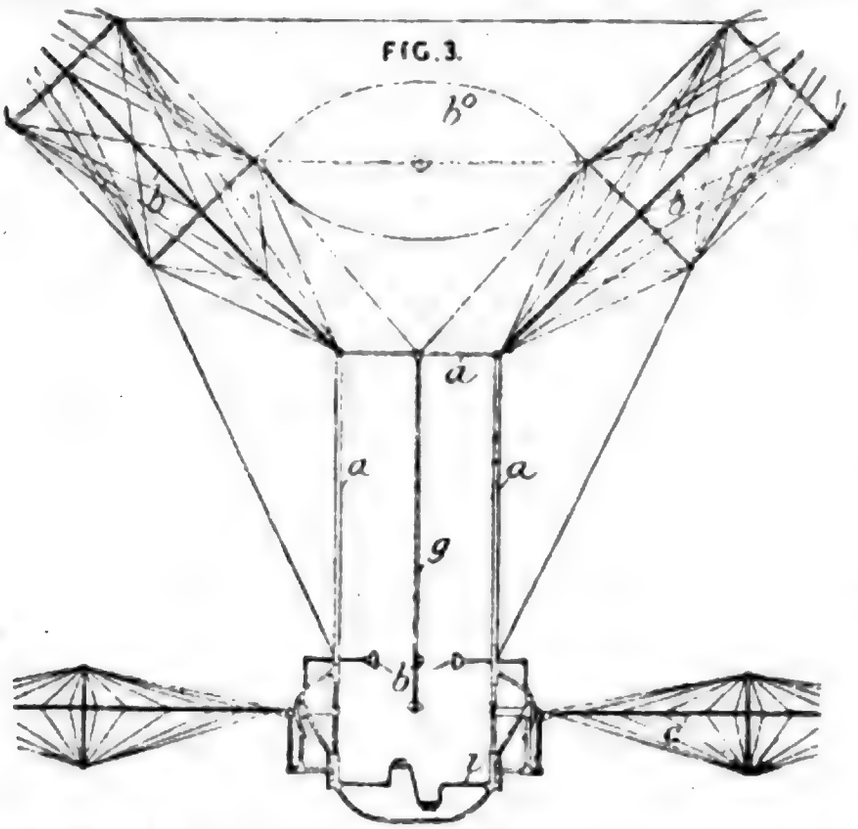


FIG 8.

The machine consists of a main frame *a*, from which is suspended a frame *g* for carrying the rider, a pair of wings *c*, *c* of the form described in

Digitized by Google

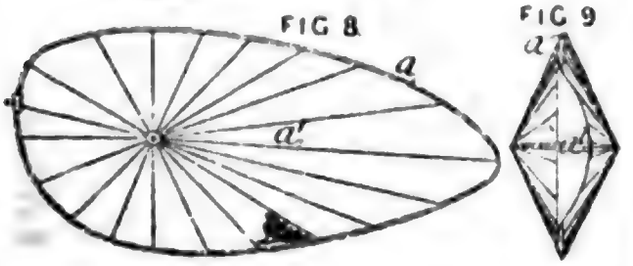


Specification No. 25,717, A.D. 1896, and a pair of aeroplanes b, b, with which may be combined an aerostat b_0. Modifications are described in which aerostats in the form of aeroplanes are employed and arranged in series one above the other at adjustable inclinations. A feathering aeroplane having hinged shutters t actuated by cranks t^1 and rod t^2, as partly shown in Fig. 8, may also be employed. A rudder with horizontal and vertical vanes is fitted to the machine. The framing is constructed of aluminium tubing or bamboo. The wings c, c are actuated by pedal cranks i, and their inclination is adjusted by handles $b9$.

25,717. November 14, 1896. **Wings for Flying Machines.** SIMMS, F. R., 12, Norfolk Street, Strand, London.





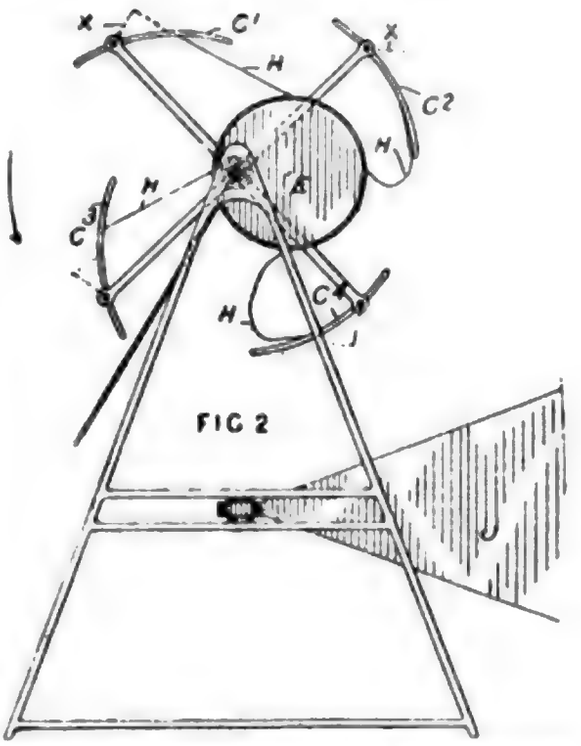


The wings are constructed of a light framework a, a^1 covered with fabric, and containing valves which open on the upstroke. The wings may be simply concave, or shaped in section as shown in Fig. 9, or flat. The valves may be circular, triangular, or hexagonal, and are closed by springs. The wing may be formed of aluminium wire or silk netting, and provided with rectangular flap valves which extend over the whole surface. Aeroplanes, arranged to permit the passage of air through them, may be employed for wings, the arrangement being as shown in section in Fig. 21, so as to offer more resistance to the air in one direction than in the other.

27,405. December 2, 1896. T. KEY. **Method of Constructing Tubular Frames suitable for Velocipedes, Motor Vehicles, and Machines for Aerial Navigation.**

29,328. December 21, 1896. F. BORDESSOUL. **Driving Mechanism applicable to Velocipedes, Boats, or Flying Machines.**

2,351. January 29, 1897. **Flying Machine.** WHITE, J. D., 3, Paper Buildings, Temple, London.



Propelling and Steering.—A wheel with feathering blades c^1, c^2, $c3$ $c4$ is employed for propelling. The blades are pivoted as shown, and are feathered

Digitized by Google

by an eccentric E, to which they are connected by cords H attached to the blades or to cranks X on their axles. The eccentrics may be adjusted to alter the direction in a vertical plane in which the machine is moving. Steering in a horizontal plane is effected by a rudder J.

United States Patents.

605,438. September 17, 1897. **Air Ship.** ADOLPH KOCHLER, New York.

Basket with rail round same, and several balloons attached to the rail.

605,579. March 18, 1897. **Flying Machine.** FRIEDRICH A. JONE, Dresden, Germany.

Lens-shaped gas container, with lateral propelling mechanism at axial centre of same.

605,596. April 19, 1897. **Kite.** HENRY H. CLAYTON, Readville, Mass.

Kite having a rectangular cell at each end, the frame comprising a corner post at each corner of cells, extending the whole length of the kite.

606,167. July 15, 1896. **Soaring Machine.** WILLIAM P. BUTUSOV, Chicago.

Soaring machine with outstretched wings and platform for rider to stand and move back and forth upon for balancing. Skeleton boat-shaped framework, rudder and keels.

606,622. September 4, 1897. **Kite.** JOHN F. COOLEY, Rochester.

Combination of kite of a horizontal wing, having front and rear bars, and slack air-resisting material between the bars, and a smaller vertical guiding-wing intersecting the horizontal wing.

French Patents.

273,723. VON ZEPPELIN. **System of Dirigible Balloons, with Several Independent Motors.**

273,857. LIGONY. **Dirigible Balloon of Special Form, called Aerial Canoe.**

274,056. DE WOLFF. **Elevating Apparatus and Motor for Aerial Vehicles.**

274,056. ADAMS. **New System of Aviation.**

LIBRARY
G 20.5
A 45

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4 1910

THE AERONAUTICAL JOURNAL



No. 8. OCTOBER, 1898. VOL. II.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	73
ADER'S FLYING MACHINE (*Illustrated*)	73
EXPERIMENTAL SOARING. PROFESSOR G. F. FITZGERALD, F.R.S.	75
BALLOONS FOR GEOGRAPHICAL RESEARCH. CAPTAIN BADEN-POWELL	76
MR. BACON'S SCIENTIFIC ASCENTS	78
EXPERIMENTS WITH AEROPLANES. L. HARGRAVE	81
NOTABLE BALLOON ASCENTS	84
DR. BERSON'S HIGH ASCENT	86
SOME BALLOON RECORDS	87
FURTHER EXPERIMENTS IN FLIGHT. MAJOR MOORE	88
A NEW DIRIGIBLE BALLOON (*Illustrated*)	88
THE KITE EQUIPMENT OF THE ARLINGTON OBSERVATORY	89
NOTES: THE HIGHEST KITE RECORD—GIAMPIETRO'S DESIGN—BALLOONS IN THE SPANISH-AMERICAN WAR—A DUCHESS AS AERONAUT—AERONAUTICS AT THE BRITISH ASSOCIATION—NARROW ESCAPE OF A PARACHUTIST—TO PARIS BY BALLOON—THE AEROSTATIC RAILWAY—LIQUEFIED GAS FOR BALLOONING	91
FOREIGN AERONAUTICAL PERIODICALS	93
NOTABLE ARTICLES	94
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED—FOREIGN PATENTS, &C.	95

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

From H. LACHAMBRE, Paris. ✤✤ *Established in England 12 years.*

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform Ladies and Gentlemen that from May to October, 1898, he will be making Bi-weekly Ascents at the Alexandra Palace, and intending Aerial Excursionists may obtain particulars of these Ascents by applying to

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCALLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

OCTOBER, 1898.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on Sept. 15th, when the following gentlemen were elected Members of the Society :—

JAMES D. WHITE, Esq., 3, Paper Buildings, Temple, E.C.

H. S. ELWORTHY, Esq., Havre des Pas, Jersey.

Prof. SIR WILLIAM CROOKES, F.R.S., &c., 7, Kensington Park Gardens, W.

M. AUGUSTE E. GAUDRON, 7, Victor Road, N.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Ader's Flying Machine.

More detailed descriptions of this apparatus, which was briefly referred to in our last number, have now been published.

M. Ader, who is a French engineer, has devoted much study to the flight of birds, and to the construction of their wings, and claims to have made a discovery which has an important bearing upon the subject of artificial flight. He has observed that Nature has adopted in the structure of the wings of birds, insects, and all flying things a special well defined geometric curve, namely, the spiral. Every feather taken separately obeys the same law; the curve is more or less accentuated according to the weight of the wing, but it is always present, and this principle, M. Ader maintains, should form the basis of all attempts at aerial locomotion. He has therefore abandoned the plane surfaces hitherto adopted, and has substituted curved surfaces, characterised, like the mysterious boomerang of the Australian aborigines, by the indispensable spiral. The wings of the "Avion," by which name M. Ader designates his invention, do not flap, and can only be moved backward or forward to permit of adjusting the centre of gravity of the apparatus. Their framework is of bamboo, and is jointed so that the wings can be folded if necessary. They are kept in position by steel wires, which act like tendons, and are covered with a light silk material. The apparatus is propelled by means of two large screws or helices, also constructed of bamboo, which are placed in front of the machine. They revolve in opposite directions, in nearly the same plane and are entirely independent. The motor that drives each of them is a marvel of power condensed into small bulk and is of little weight.

The motive power is furnished by steam. The fuel employed is alcohol. Each of the motors has four cylinders and operates by double expansion. The generator is tubular, and the vaporisation therein is practically instantaneous. When all the exits are closed to the steam, the pressure rises one atmosphere per second. The waste steam liquefies in an air condenser that is placed at the top of the apparatus and that permits of recovering the water without any lose.

Each motor is of 20-horse power. All the parts were worked out of blocks of forged steel, just as a bust is carved out of marble by a sculptor. Everything has been hollowed out that could be, and the result is that the total weight of the generator, motor, and condenser is about 6½ pounds per nominal horse power. The motor alone does not exceed the weight of 2 1-5 pounds per horse power.

As each motor directly actuates one screw, the velocity of either can be diminished at will; the result is that, in the steering, the propellers concur with the independent rudder situated at the rear. The latter is manœuvred by the aeronaut by means of pedals. Three or four buttons or handles, placed within easy reach, suffice for all the other manœuvres.

Digitized by Google

It measures about fifty feet from the tip of one wing to the tip of the other, and weighs, when fully loaded, about half a ton.

The French Government, keenly alive to the possibilities of the flying machine in warfare, supplied the funds for the construction of the machine, and M. Ader has been at work on it for the last five years, operations being carried on in secret, under the supervision of a committee of military experts. In October of last year the machine was finished and was conveyed to the manœuvring ground at Satory to be tested, strict orders being given that no strangers should be admitted to witness the experiments. Nature, as if jealous of her secrets, generally proves unkind at the critical moment on such occasions, and for a whole week the weather was so windy and unsettled that it was judged inadvisable to experiment with the machine, but on the 14th of October the day was calmer, and M. Ader took his place on his apparatus and set it going. With wings outstretched, the machine ran along on its wheels, slowly at first, but with a gradually quickening pace. At last the onlookers saw the wheels leave the ground, and the machine turned slightly owing to the breeze. The moment of M. Ader's triumph had come, but it was of short duration. A second later a squall struck him, and, fearful of the results, he slowed down. The machine immediately dropped to the ground, and the wheels being no longer in the line of motion did not run, but jammed, One of the wings broke, the machine fell on its side, the screws were smashed to atoms, and when M. Ader



PREPARING FOR THE FLIGHT.

[Illustration from *Golden Penny*.



WITH WINGS OUTSTRETCHED.

[Illustration from *Golden Penny*.

Digitized by Google

got free of the wreck he found only his engines intact. However, the machine had actually raised itself into the air—everyone was positive on that point—and so the committee of experts, in their report to the Minister of War, stated that in their opinion the experiments should be continued, it having been proved that the motive power was sufficient to lift the machine, and that the wings were capable of carrying the apparatus and its inventor.

The machine has now been repaired, and being furnished with wheels that will turn in any direction, a similar accident is no longer possible. The inventor is only awaiting the order of the Minister of War to make another start, and any day we may hear that the problem of aerial navigation has been solved.

Experimental Soaring.

Some years ago I got over a soaring apparatus from Lilienthal, and made some experiments with it in Trinity College, Dublin. The college grounds are flat and sunk below the city and surrounded by trees, so that it is a very unfavourable place for experiments of the kind. The conditions for successful soaring are a pretty steep incline *up* which the wind blows, and the only incline I could command was an inclined scaffolding I had erected, round which the very gusty wind blew, making it very difficult to keep any sort of balance even when standing. I also made experiments with the willing assistance of several students on being dragged along against the wind. I found that this was a rather dangerous experiment, partly on account of the irregularity of the gusty wind and partly on account of the difficulty of controlling a number of students, when once started in a team running across the Park. The gustiness of the wind made it impossible for me with the little practice I had had to keep the plane of the machine level, and one wing thus scraped along the ground. If my team of students could then have been quickly stopped, there would have been but little danger, but, as it was, there was considerable danger that the ribs on the side scraping the ground being broken, their splinters should be driven into me, an accident that might have very serious results. I also tried experiments on sending up the apparatus as a kite by itself, and with myself and a light student in it. I had several guide ropes to ensure its not diving in the way that kites so frequently do when rising in the gusty air near the ground, and I found that, even in the gusty air of the College Park, the apparatus flew admirably as a kite. During pretty strong gusts it was almost able to raise my weight (about 11.5 stone), and was well able to raise the student.

As a result of all my experiments, I am quite confident that, in a steady breeze, it would be quite feasible to soar with apparatus of this kind, and am writing this article in hopes that some person who resides in a suitable locality will make experiments in furtherance of our knowledge of how best to balance a soaring machine. If the experiments are conducted on the lines I indicate, I do not think that they need be dangerous; but nobody should lightly undertake experiments of the kind nor should they venture to rise more than a few feet from the ground without having made innumerable experiments at small heights on the lines they intend to follow at greater heights.

The kind of locality suitable for these experiments is an open, pretty steeply sloping field, where there would be a good prospect of having a steady breeze blowing straight up the slope. Herr Lilienthal constructed a conical hill, in order that he might be able to make experiments thereon in every direction, so as always to face the wind. No artificial mound of this kind can however be large enough to deflect the wind much upwards. The wind will largely blow *round* it, while it is essential for the experiments I desire to see tried that there should be a considerable upward component in the wind. From my experience, I should say that some locality near the sea would be found most suitable, as the wind near the sea coast blowing from the sea is generally very much steadier than the wind at inland stations, and, certainly at first, it is important that the wind be as steady as possible, so as not to increase the difficulties of the experimenter.

Having selected a suitable locality and a suitable day, the experimenter should have two long ropes fastened to the lower side of the soaring machine, and attached to two points in that lower side about four feet apart. From that they should stretch, making an angle of about 60 degs. with one another, to two fixed anchorages at the bottom of the slope. The soaring machine should be near the top of the slope, and should be fastened by short ropes to anchorages in its own neighbourhood, these being so arranged that the machine may not be able to rise more than five or six feet from the ground, nor when so high be able to dive forward or backward. All this having been carefully ensured by experiments made with the machine, thus flying like a kite with its several guide ropes, the experimenter might

get into the apparatus, and, if the wind were strong enough, he should have no difficulty in flying like a kite, with the various guide ropes all tight. All this can undoubtedly be secured, as I and other have gone so far. The next thing to do is to try and arrange one's balance in this kite, so that it may lie sloped a very little downwards in a forward slope. Kites always fly sloping upwards, but on the upward draught of air on a hill slope must be possible to fly with the kite sloped a little downwards toward the wind. In this position the drag on the forward ropes would cease, and the kite, if too much sloped forward, would tend to slide down the air in the way that Herr Lilienthal so frequently succeeded in doing. This would, however, be stopped by the guide ropes I advocate, and is not the action I think should be aimed at. What the experimenter should aim at is such a slight forward slope as would only just relieve the tension on the forward ropes, and leave him and the aeroplane balanced in a steady, or nearly steady, state on the draught up the hill slope. This is an action we frequently see used by seagulls on the sea cliffs. They stand with motionless wings balanced on the upward air current near a cliff or hill, and can, by merely changing their balance, sail foward or backward, upward or downward, to one side or the other, without any exertion of power. Before we can hope to emulate their many actions, we must learn to balance ourselves on the upward air current by means of the aeroplanes, and I believe that constant practice with the aid of guide ropes such as I described would enable a careful experimenter to learn the art without any serious risk.

Besides the delight of being able to accomplish so much, and the hope that one might in time, and with favourable breezes, emulate the manoeuvres of seagulls, a great deal of valuable information could be acquired as to the general question of balancing in the air, and on the effect of gusts of wind, and possibly as to the ultimate utilisation of the gusts as means of flying. The accumulation of experience by careful experiments is in every way desirable, for without a great deal more experience than we at present possess, it is impossible to say how far we may be able to imitate birds without a large expenditure of power on our part. There can be no doubt, that the power at the disposal of birds is far greater than they require for much of their ordinary work, and I have no doubt that under favourable circumstances we could utilise the wind to provide us with the power required in the same way that, there can be no doubt, many birds do.

I may make a remark as to the possibility of using a perfectly uniform breeze, which seems to have been overlooked by those, and they are many, who do not see that it is impossible to do so continuously. The air we live in is always blowing along at a most tremendous rate. It is going about twenty miles a minute at the equator along with the rotation of the earth on its axis, and about nineteen miles a second along with the earth round the sun. Why cannot we use these desperate hurricanes to fly by? How do they differ essentially from any other perfectly steady breeze?

GEO. FRAS. FITZGERALD.

Trin. Coll., Dublin, July, 1898.

Balloons for Geographical Research.

By Captain Baden-Powell.

(Extract from Paper read before the British Association at Bristol.)

Many difficulties beset explorers in wild countries. Much time has to be devoted to the journey; transport of supplies, hostility of natives, progress through jungles, marshes, and rivers impede the traveller. Long sojourns and hard work in hot and unhealthy climates, or extreme cold, all present great difficulties. There is, however, one high road which leads unobstructed to all parts — the air. An aeronaut, seated in the car of a balloon, floats along above all impediments and obstructions, travelling day and night at the speed of the wind, and with an extensive view of all the country below. But there are two practical difficulties to be overcome. First, the ordinary free balloon must travel wherever the wind chooses to take it, and that may be in any but the desired direction; secondly, no free balloon has as yet ever remained up longer than a day or two.

The question thus arises, can a balloon be sufficiently improved upon to make it a serviceable means of geographical exploration? As for being diverted out of an unsuitable wind course, three general methods for doing so have been suggested and even tried: (a) To propel the balloon with a screw or other propeller after the fashion of a steamer, or, rather, a torpedo. Many attempts have been made in this line, but the most satisfactory only resulted in a speed of about 14 miles an hour, insufficient to stem any but light breezes. However, if such an apparatus could be practically

Digitized by Google

propelled at this speed for many hours on end, it would prove of the greatest value for our purpose, a considerable deviation could be made from the actual direction of the wind, and a direct course steered during light winds and calms. (b) To take advantage of varying currents of air at different elevations. This method, however, cannot be relied on. Though there are occasionally different currents at different heights, there is by no means any certainty of finding suitable ones (at all events out of the regions of trade winds). (c) By having a connection with the ground, such as a heavy guide rope. This, by its friction retards the speed, and enables a balloon, if fitted with a sail, to be steered to some extent out of the wind course. This system, first suggested by Green, and practically utilized by Andree, has the advantage of being very simple, and the guide-rope also performs other valuable functions. Andree hoped to be able to maintain as great a deviation as 30 degs. on either side.

One of the chief causes of the ordinary free balloon giving out so soon, is owing to its varying elevation. When suspended in mid air it forms a very delicate balance. The least addition of weight, such as the damp from a cloud will cause it to fall. The least lightening of it, as from the expansion of the gas by a warm sun, makes it rise. These continual elevations and depressions necessitate a loss of gas and of ballast. Here again various ideas have been brought forward to rectify this drawback. Vertical screws, worked by hand or by a small motor, might prove of use, though ballast, to compensate for loss of gas, or for any great acquisition of weight as from a shower of rain, would have to be taken too. A pump to compress the gas, or atmospheric air, is theoretically a good means of obtaining the requisite addition of weight when required, but in practice the apparatus is too cumbrous. Lamps to heat the gas have been suggested, but one is apt to forget the enormous volume of a large balloon; it may be compared to warming a large hall with a small spirit lamp. Liquefied gas may in time be employed, though perhaps hardly practicable at present. The addition of a long guide-rope trailing on the ground is, however, a most efficient means of regulating the height at which a balloon is to float. Every tendency to rise necessitates the lifting of more weight of rope. Every downward movement lays more on the ground. The guide-rope, then, is a most important adjunct, though seldom applied in practical ballooning, solely on account of the damage it would cause to crops, houses, etc., in civilised countries.

Actual leakage of gas is not a serious matter with a good balloon, as sufficient ballast can be carried to compensate for it. Goldbeater-skin balloons are undoubtedly the tightest. A balloon at Aldershot has remained inflated for three months on end with very little loss. Andree, on the other hand, with his silk balloon, had the greatest difficulty in stopping up the needle-holes of the seams.

The idea of utilising a "Montgolfier" or hot-air balloon is out of the question, as requiring such an immense supply of fuel to keep it up for any length of time.

There is one more method of travelling through the air which is worth mentioning—that is, man-lifting kites. I have previously demonstrated the feasibility of lifting a man by this means, and doubtless there would be no practical difficulty in lifting a car with several men and supplies. I have also shown that if the lower end of a kite string be attached to a loose heavy rope, the kite will tow it along over the ground, and itself remain in the air even supporting a considerable weight. Here then is a method of utilizing the guide rope without the leaky, touchy, and delicate balloon! Rough calculations, however, tend to show that an enormously heavy rope would be requisite, too large in all probability to be practically manageable.

Having come to the conclusion, then, that a balloon is a practical means of exploring unknown countries, we may consider what will best constitute our equipment. Before deciding on the details of a balloon outfit for such a journey, the locality must be named. Considering all things, I know of no country which presents so many most desirable qualifications as Egypt; steady northerly winds always prevail up the Nile, the deserts on either side are most favourable ground for trailing over, Cairo forms a well supplied base to start from, and the longer the journey is continued, the more interesting does the country become. I think the following would form the most suitable equipment for such a country.

I should suggest several balloons. One of about 60,000 c. ft. and, say, six smaller ones of about 7,000 c. ft. Then, if one gets torn or damaged, the others might remain intact. After a time when gas is lost, one of the smaller ones could be emptied into the others, and the exhausted envelope discharged as ballast: the smaller balloons would be easier to transport by porters than one big one; and they could be more easily secured on the earth during contrary winds.

Over the main balloon a light awning might be rigged to neutralize as far as possible the

Digitized by Google

changes of temperature. A lightning conductor to the top of the balloon might be desirable. A large sail would be arranged, and a bifurcated guide-rope attached to the ends of a horizontal pole would form an efficient means of steering. The car would be boat-shaped and waterproofed, so that it could be used for a return journey down a river. Water-tanks would be fitted. The weight would probably be somewhat as follows:—

	lbs.
Balloons, with nets and cover	2,000
Car, with water tanks	400
Four men, with personal effects	800
Sail, pole, anchor, and cables	200
Guide-rope (portion suspended)	1,000
*Food, 30 days at 3 lbs. per man and waste	400
*Water, ,, ,, 1 gallon ,,	1,200
Instruments, guns, cooking apparatus	200
Ballast (for emergencies)	800
	7,000

* Daily consumption of these two, 53 lbs.

The 100,000 c. ft. of hydrogen which the balloon would contain would just about lift this (regulated by the guide-rope). If the loss of gas amounted to as much as 2 per cent. per diem, it would be compensated for by the discharge of 140 lbs. of ballast, but the ordinary consumption of supplies and the occasional discharge of a balloon would account for a large portion of this. Thus, it is evident that the balloon might be able to keep afloat, if necessary, for over three weeks, leaving a good supply of provisions. If the speed averaged 12 miles an hour, the journey could be prolonged for 6,000 miles!

Mr. Bacon's Scientific Ascents.

A series of experiments in aerial research have, during the last three months, been carried out by the Rev. J. M. Bacon. The objects in view were numerous, but acoustical tests were the chief features. The following were laid down as the special objects to be achieved:

To test many forms of speaking trumpets, transmitters, and receivers.

To discriminate between the audibility of band instruments, singly and in concert.

To make investigations (various) of echoes, "acoustic clouds," and the decay of sound on diverging from axis along which generated.

To measure velocity of sound between earth and upper strata.

To experiment on pitch and audibility of instruments taken aloft.

To decide the maximum range down wind (1) of human voice; (2) powerful sound instruments.

To note rise and fall of sound of church bell, as heard remote from local influences, e.g., whether merely fitful, rhythmic, or otherwise.

To look for conspicuous stars before sundown, noting their altitude and angular distance from sun.

To look for alleged markings on the surface of Venus.

To note any darkening of the sky in ascending.

In regard to refraction, to take snap-shots of the sun disappearing below sea horizon at known times and altitudes, with simultaneous temperature measurements.

To observe and photograph the spectrum below and aloft, determining the proportion of telluric lines, etc.

To investigate by photography the relative actinic qualities of the atmosphere at different elevations.

To measure atmospheric electricity by a Kelvin's electrometer.

To experiment with Aitken's dust counter.

To entrap air at high elevation, to be examined by Professor Ramsay.

To record the lag of aneroid barometers during descent.

To attempt to photograph the Solar Corona from high altitudes.

Mr. Bacon, it may be said, is an old scholar of Trinity College, Cambridge, who although ordained, has devoted his life to astronomy and other sciences. He has a splendidly equipped observatory and laboratory at his home in Thatcham. It was at his own workshop that most of the instruments made for his researches recently were manufactured. His parabolic receiver, or sounding board, has been made by Mr. Maskelyne, of Egyptian Hall fame, with brown paper. The speaking-tube was based upon the tube used in the Spanish Navy, and the sound receivers were old casks ingeniously wired and utilised for this business.

The first ascent of the series took place on July 27th, in the grounds of Shaw House, near Newbury, in the presence of several thousands of spectators. The experiments were carried out under the direction of the Rev. J. M. Bacon, Dr. R. Lachlan, Mr. J. N. Maskelyne, and others, with the advice and assistance of Lord Kelvin, Lord Rayleigh, and other scientists. The balloon was in charge of Mr. Percival Spencer and his brother, and was filled

Digitized by Google

with 40,000 cubic feet of gas. The ascent was successfully made at twenty minutes past five o'clock, the balloon drifting steadily in a north-westerly direction. As soon as the balloon had had a fair start, the series of experiments commenced. The first experiment in acoustics was with the voice, followed by five tests with musical instruments, these being succeeded by the discharge of rifles and blasts of the syren from an engine. Then came a rifle volley, a roll of musketry, and discharges of cotton-powder, 4 oz being used in each charge. After this came three further discharges of cotton-powder, with 8 oz. in each charge. When the balloon had travelled a considerable distance, there were two explosions of cotton-powder with double charges, the final experiment being a comparison between a discharge of 4oz. of gunpowder and 4oz. of cotton-powder. The aeronauts had with them a receiving instrument, and by noting the altitude and the sounds which reached them, took the angular distance. The balloon made an excellent descent at ten minutes to seven o'clock at North Denford All the experiments proved highly successful.

Mr. Bacon made a second ascent on Aug. 12th. As assistant, he chose his daughter, Miss Gertrude Bacon, who, as a working member of the British Astronomical Association, has accompanied her father on the last two eclipse expeditions. The inflation of one of Messrs. Spencer's larger balloons commenced about noon in the Crystal Palace grounds About this time, however, the breeze began to freshen considerably, and shortly became a strong wind. At about half-past four in the afternoon, the ascent was made, and the balloon rapidly rose to nearly 6,000ft., at which elevation it sailed over London at a great speed, crossing the Thames between the Tower and London Bridges. The view was exceptionally fine, and the cameras were busy. It is stated that important observations were made, including some remarkable aerial echoes and other acoustical effects. The spot chosen for the descent was near Ashwell, in Hertfordshire. Here the anchor scorned the hard surface, and there commenced a lively little steeplechase across empty harvest fields, the car boldly charging banks and boundary posts. Eventually it was brought up on a roadway, and Mr. Bacon and his daughter were able to proceed to Cambridge by the last train.

The third ascent took place on Aug. 20th from the Crystal Palace, the descent being made at Rainham in Essex.

Mr. Bacon, in the "Daily Mail," relates:—

The fourth of the present series of balloon ascents took place at the Crystal Palace on Saturday, September 3.

In addition to meteorological records it had been determined to take photographs from high elevations, to collect air at different heights for subsequent examinations, to test the proportions of foreign matter in suspension, and to make experiments on the behaviour of sounds under fresh conditions of atmosphere and locality.

It was desirable, if possible, to attain an height of several thousand feet, and to continue the investigation as long as practicable. On the eve of starting I appealed to our aeronaut, Mr. Percival Spencer, and asked him if, as the day was calm, he could not dispense with the extra weight of his heavy anchor and trail-rope.

The afternoon was perfect for our purpose: warm, still, and almost cloudless, with only such summer haze as tones the sky to greyish blue. Suburban London looked its brightest. For a while we lingered over well-known haunts. We took frequent snapshots as we drifted slowly to the S.S.E. at a height of hardly half a mile. From the moment of starting one peculiarity in the physical conditions prevailing was abundantly apparent. The air was not in fittest mood for conveying sounds. The cheering of the crowd in the Palace grounds had quickly faded.

In twenty minutes from the start we were sailing over Bromley. Presently Tunbridge and Tunbridge Wells lay beneath us. Then 4,000, 6,000, 8,000 ft. were rapidly recorded. Soon we looked down from a mile and three-quarters high. What a sight it was!

The sea was well in sight. Beachy Head stood bold and bluff on the right. Dungeness was away on the west as far down, but straight in front and rapidly approaching, were unmistakable outlines of the twin towns of Has..ngs and St. Leonards.

We were already over the houses. Beyond them were the cliffs 100ft. high, and beyond—the open sea.

Already we were swooping down with a rush.

"Ready with this sandbag," broke in Mr. Spencer, "and look out." The next moment circumstances were all altered, as we were caught by a strong undercurrent, and wafted towards Fairlight. And so we cleared the housetops after all, and coming down in a harvest field, bowled over on our side before a stiff sea breeze, with, of course, no anchor to hold us.

Post and rails were ahead, but we crashed

Digitized by Google

through them unchecked, and now only a belt of trees barred us from the cliff. The next moment a brave old oak brought us up.

The fifth ascent of the series took place at the Crystal Palace on Saturday, Sept. 10th. Mrs Lachlan, wife of Dr. R. Lachlan, of Cambridge University, occupied a seat in the car, Mr. Percival Spencer being in charge. Experiments in acoustics were made, and photographs of the country crossed taken. The balloon at times reached an altitude of about a mile. After four hours' journey a descent was made near Dover.

The sixth ascent was on Sept. 12th, from the grounds of Clifton College. The following is the graphic account which Mr. Bacon gave to a "Daily Mail" representative:—

"The arrangements were perfect throughout, and at 4.30, the hour of starting, the balloon was straining at her moorings, and 2,000 onlookers, the specially invited guests of the British Association, lined the enclosure. A few genial well-wishes from scientific friends, and a parting word from Professor Ramsay, on whose behalf it was my aim to bring down a sample of the atmosphere from our highest elevation, and Mr. Percival Spencer and myself were up and away.

"We rose at once 3,000 feet, from which height we looked down on surely one of the most noteworthy spots on earth, through an atmosphere which, despite all the smoke that Bristol could produce, was the clearest I have had experience of in the upper regions this season.

"Our observations aloft quickly showed us a temperature markedly lower, and far less thirsty than we have yet recorded. From the North Atlantic a cold, moist current was sweeping by, not half a mile above parched and panting England. It had manifestly altered the conditions of floating matter.

"The dust counter gave a reading practically nil at a stratum where six weeks before hovered an ocean of dust-motes. The light reflected out of the air, and sifted by the prisms of spectroscope and polariscope, told the same tale in different language, and the upper air, tested for photographic action, showed a rapidly altering rate, while its power of conveying sound was very remarkable indeed.

"The conditions seemed identical with two days before, when the toot of a horn came back to us from earth over 2,400 ft., occupying nearly five seconds in making the double run.

"One more example of the carrying power of air that afternoon. At a full half a mile up, while flying over Keynsham, a piece of thistledown passed us, and in a great hurry too, still mounting upwards. It seemed to have a mission to fulfil before nightfall, when descending cooler currents would bring it down.

"This was our case also, and when we had taken our sample of air at the greatest height we prepared for a descent, which, all ballast being spent, took place rapidly.

"We came to earth near Frome."

On Sept. 28th a night ascent was made by Mr. Bacon with Mr. P. Spencer and a reporter of the "Chronicle," from the Crystal Palace After attaining an elevation of 3,000 ft., a descent was made at Aylesford, in Kent.

Aeroplane Experiments.

By L. Hargrave.

(Paper read before the Royal Society of New South Wales.)

Since the paper on the possibility of soaring in horizontal wind was read, no efforts have been spared to determine the essential features of curved surfaces that are of any practical utility to aeronautics, and the model shown in Fig. 1 embodies what is known to date. The poles and horizontal cord have been found a most useful method of experimenting; indeed, it may safely be said that without them the trifling amount of available wind would have been quite inadequate to find out anything new. As suggestions to those who wish to advance this matter rapidly, it may be stated that the wind near the ground is comparable to the surf on the sea shore, which all will admit is not suitable for testing the sailing capacity of yachts or boats. To utilize wind from all directions, a platform of wire netting should be placed in a situation like the top of the shearlegs on Garden Island. The top of a building, cliff, or rugged mountain would be unsuitable as walls and vertical surfaces merely create the aerial breakers which it is the wish of the experimenter to avoid.

It is well at this point to have a distinct understanding that soaring is quite different from kite-flying and gliding. In gliding, as practised by Lilienthal and others, a free apparatus descends from an eminence, and its fall is more or less retarded by the air on which it slides. In kite-flying, a weight attached to the earth is raised and supported by the wind sliding under it. In soaring, the mechanism is unattached to the earth, and maintains its elevation by using as a motor the vortex that its peculiar shape generates. Most people would at

Digitized by Google

once say the last statement involves perpetual motion, and therefore is not worth considering; a few will see that a ball retaining its position in front of a nozzle against gravity and the downward thrust of a high-pressure jet of water is a close analogy to the soaring vortex. The water clearly makes the ball weigh less than nothing. There is little doubt that the weight of a ball dancing on a fountain is greater than when it is at rest.

The makers of soaring models will find great difficulty in persuading them to remain tolerably stable in a fore and aft direction. The trouble will be greatly reduced if they avail themselves of the experience of a tight-rope walker with his balancing-pole. The acrobat makes his pole as long and stiff as possible, and puts as much weight on the ends of it as he conveniently can; he then has no further difficulty with his athwartships stability. It is the inertia of the weighted ends that takes the wobble out of his body. Likewise the weighted ends of the fore and aft tubular rod in Fig. 1, check the erratic motion of the vulcanite propeller.

When you consider the conformation of a soaring bird, it will be noticed that a large part of the under surface is not adapted for the formation of the soaring vortex. The tips of the rigid wings and tail are obviously of such a nature that they will not readily allow the bird to rise or fall suddenly when the soaring parts of the wings are struck by a gust from underneath or above. These surfaces are represented in Fig. 1 by the horizontal projection of the surfaces of the two cylindrical cells at the ends of the tubular rod. The vertical projection of the two cells represents the vertical surface of a cellular kite or the dihedral angle of some soaring birds.

The parts of a soaring bird's wings next to the body are represented in Fig 1 by the bent sheet of vulcanite. This is the propeller, and it makes sufficient thrust to overcome its own head resistance and that of the rod and two end cells. No attempt has yet been made to ring the changes on the numberless curves that probably soar; the essential points seem to be that the front part of the propeller shall be bent to about the quadrant of a circle, the extreme after part plane, and the intermediate portion hyperbolic. Rigidity of construction is all-important. Springy and vibratory surfaces are not conducive to steady soaring; their practical effect is to increase the head resistance. No curved surfaces made of muslin have yet soared; the nest for the vortex must be hard and smooth.

The tubular rod and two end cells form really a cellular kite, and their head resistances are reduced to the utmost. In Fig. 1 the total area exposed is 1.27 square inches, without making any deduction for rounded edges. In addition to this there is the drift of the two strings,

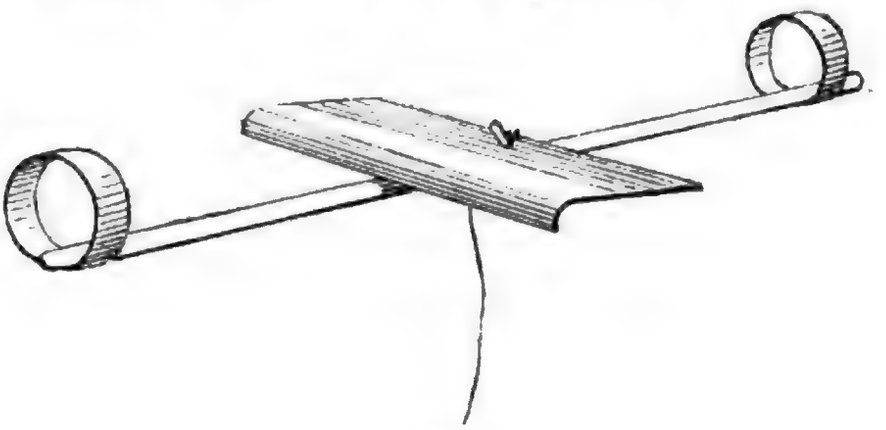


FIG. 1.

which in practice will be dispensed with. The horizontal projected area of the cylindrical cells is 46.8 square inches, that of the propeller 165 square inches, total 211.8 square inches; the total weight, 1.53 lbs., give a weight of 1.04 lbs. per square foot.

The force of the wind required to make any show at all with the model depicted must be at least fourteen miles per hour; light north-east and west winds have been a sore trial to the writer's patience, south-east and east being the only winds from which any results can be expected in the locality where the experiments are being carried on.

The centre of gravity in Fig. 1 is 2.6 inches abaft the leading edge of the propeller, and 3.725 inches forward of the middle of the tubular rod. The string is attached to the centre of gravity. The vulcanite propeller is fastened in such a manner that the angle it makes with the rod and cells can be varied from + 1° to − 14½°; the best results in light

winds have been obtained with about 3½ degs. negative angle. There is no way of finding accurately at what angle the wind strikes the cells; the rod appears to be horizontal.

A light string is tied to the after end to prevent the kite rushing over the horizontal cord; this string is slackened out till the kite is near the level of the top of the poles and in a horizontal position facing the wind; it then soars to windward, sometimes over but more frequently under the cord. Sometimes the kite can be steadied near the zenith by means of the tail string.

The question arises as to what is the use of trying to make a large soaring machine, if under ordinary circumstances one may wait weeks for a few hours' trial with small models. Irrespective of the pleasure to be derived from attempting to unravel Nature's secrets, there is the prospect that an apparatus fitted with soaring curves may be raised by thrust in calm weather with greater facility than the ordinary screw-driven aeroplane; and that although the air is calm near the earth's surface, a few hundred feet elevation would bring the machine into disturbed air, where the soaring curves would develop their full power and the machine could then proceed without steam.

The late gales (May 5) enabled me to find out that the pounds per square foot suitable for a fourteen miles per hour wind did not give as good results in thirty-five miles; and served to show that there are three cases in which soaring is possible:

Case 1. When all the surfaces are shaped for soaring. This form of apparatus will be extremely difficult to steer.

Case 2. When the cellular kite part of the machine is inclined at a slight positive angle This form is for use in the lightest winds in which soaring can be done.

Case 3. When the cellular kite as well as the propeller is at a negative angle. This is for very strong winds.

There is no reason why the propeller should not act if the axis of the vortex is not horizontal. Possibly concentric ring propellers may be found to give steady and uniform results with little weight. The kite shown in Fig. 1 has been greatly improved by increasing the rigidity of the tubular rod; it is now .55 inch external diameter, and all the ballast is put inside the ends. There is 12.75 inches of .5 inch round lead in the forward end and 6.75 inches inside the tail. This brings the weight up to 1.9 lbs. per square foot. When loaded to 1.87 lbs. per square foot with a wind of sixteen or seventeen miles per hour, the propeller set at a negative angle of 6.3 degs., and centre of gravity 3 inches abaft the leading edge of the propeller, it has frequently soared to the end of its tether.

The soaring kite with the double propeller rolls very sharply; this is thought to be due to the centre of gravity being too low. The rod is now clamped to the steel wires joining the two parts af the propeller, in such a way that it can be adjusted vertically.

As it seems impossible to arrange for the members to see these particular experiments, it is thought that an accurate drawing of the model is amply sufficient to enable others to reproduce and extend the elementary observations here recorded.

The principal points that require investigating, are:—

1. How much the after edge of the propeller can be cut away without impairing its officiency?
2. What is the diameter of vortex that is best for general use?
3. How many propellers can be advantageously superposed?
4. The proper relation between the propeller area and the kite area.
5. The shortest rod that will keep the longitudinal equilibrium stable.
6. What is the supporting power of the propeller when used for gliding, as compared with that of the gliding machines now used?
7. Can the vortex be produced by a motor in calm air, so as to be more economical than the thrust of a screw?
8. To make an instrument to show simultaneously what pressure there is at every part of the concave and convex surfaces of the propeller.

These alone form a large volume of work for one pair of hands to endeavour to accomplish, and it appears regretable that Australians should leave to Americans and others the tardy adoption of the views circulated by this Society.

A steam screw motor, which is intended to develop five or six horse power, has taken up much time, but as yet it will not work in a reliable manner. It is of course quite a secondary consideration while the soaring kites are developing. The water is contained in the square part of the tubular frame, and the kerosene in the centre upright part. The cylinders (2) are 4.25 inches diameter, the stroke is one inch, and they rotate with the screw. The shaft is clamped to the frame. The boiler is made of one hundred and twenty-four feet six inches of 5-16 inch copper pipe, with 10.27 square feet outside heating surface; the capacity is 88.4 cubic inches. Weight of

pipe is 8.37 lbs., coiled eight and a-half inches outside diameter. The upper two-thirds of the pipe branches into two parts, joining again at the steam pipe. The fuel is vaporised in seven feet six inches of one-quarter inch copper pipe coiled inside the tin burner casing shown under the boiler. The total weight of the motor exclusive of water and kerosene is 36.5 pounds.

The principle that long continued thought on any subject must tend to a clearer view of the detail connected therewith, has encouraged me to state some considerations as to the disposition of the supporting surfaces of flying machines that do not seem to have yet struck other experimenters.

It has been usual to make the lifting surface in one or more pieces rigidly connected to the weight to be lifted. In the machine for the engine, it is intended to depart considerably from this practice by dividing the required surface into numerous small aeroplanes, all attached to the weight by one wire.

The aeroplane derives its lifting power either from moving air passing it when attached to the earth, or from being moved horizontally through calm air; in either case there is no necessity for the aeroplanes to be connected to the weight by rigid booms and numerous stays, as the lift and drift can act only in tension and in one vertical plane. By dividing the surface into a number of small planes, any refinement of curve may be introduced with the certainty that the advantage accruing therefrom will be effectively used, and that the head resistance will be reduced to a minimum.

It will be obvious that forty aeroplanes of ten square feet area each can be constructed with much less material for spreading them horizontally than one plane of four hundred square feet area. In fact, we are substituting arithmetical for geometrical progression in the weight of our surfaces and their head resistance, and lifting our machine pound by pound with foot by foot of added surface. We are also able to unite very large and therefore more efficient engines with the extraordinary lifting power known to exist in small and carefully curved aeroplanes. You will gather from these remarks that the proposed flying machine will be a rather tall structure, and that fact alone will make it extremely easy to work and certain in its action.

The most suitable time for experimenting will be when the wind velocity is slightly below that at which the machine is designed to fly. The aeroplanes are sent aloft kite fashion, the anchor restraining the drift. Steam is then raised and the propeller started; if it is driven hard enough the machine rises over and picks up the anchor; if the power is insufficient no risks have been run, and there are no damages to repair.

There is no special gear for causing the machine to ascend or descend; it is simply a matter of more or less steam. The turning to the right or left is done by pulling slightly on one or other of two strings attached to the forward corners of some of the lower aeroplanes. The weight is kept from spinning round by some small vertical surface to the rear of and in a line with the thrust of the propeller, so that it is immaterial whether the weight is deflected by the small vertical surface and pulls the aeroplanes after it, or the aeroplanes are made to shoot to one side by the strings and pull the weight after them. There will probably be an advantage in the motor working in air of less velocity than the higher current when going to windward.

It is not generally understood that when the motor has succeeded in thrusting sufficiently hard to run over and lift the anchor, the aeroplanes exert a steady lift on the motor, and that whether the wind blow high or low, or change its direction, the whole apparatus maintains a uniform velocity through the air as long as the engine maintains a uniform speed. Of course the machine will drift with the air currents, but this set has to be allowed for and a course shaped accordingly. The set of the air current would be unknown if the earth were invisible: in like manner that the set of an ocean current is not ascertainable when out of sight of land without the aid of astronomy.

If there is no wind at all, there is no means of getting this form of flying machine aloft except by making a more or less extended run along the ground. This run may be then made round a circular track. In the event of the motor stopping, the machine does not fall vertically as a parachute, but slides down gradually in any desired direction. These remarks refer to the screw-driven aeroplane machine; if soaring propellers are substituted for some or all of the aeroplanes, a new power is introduced that completely modifies all preconceived conditions.

Notable Balloon Ascent.

(From "Daily Telegraph," Sept. 17, 1898.)

Mr. Stanley Spencer, the well-known aeronaut, and Dr. Berson, of the Berlin Observatory, ascended from the Crystal Palace in a balloon inflated with pure hydrogen gas, and reached

Digitized by Google

the remarkable height of 27,000 ft., more than five miles of vertical altitude, which is only 1,500 ft. less than that recorded by Coxwell and Glaisher in their celebrated trip of Sept. 5, 1862. To obtain some particulars of this noteworthy ascent, a representative of the "Daily Telegraph" called on Mr. Stanley Spencer, who was found at the balloon works of Messrs. C. G. Spencer and Sons, Canonbury.

"If you wish to know what scientific observations were made," he said, "I am afraid they will not be obtainable for a week or so. They were made in sealed instruments, and Dr. Berson is now on his way to Berlin with them. I may say that Dr. Berson was extremely pleased with the results, and declared that this ascent was the most successful of the series that he has been making at St. Petersburg, Moscow, and Berlin. I was present simply in charge of the balloon, and I have only the records made by my private thermometer and barometer. The aneroid showed that we had ascended to 27,500 ft., and the thermometer registered —29 degs. Fahrenheit, or 61 degs. below freezing-point.

Mr. Spencer proceeded to describe the trip. The balloon had a capacity of 56,500 cubic feet, and was inflated with 40,000 cubic feet of pure hydrogen, and to it was attached a basket-car 3 ft. 6 in. wide, 5 ft. long, and 3 ft. deep. The greater portion of the recording instruments were slung from the network of the balloon, so as to keep them at a distance from the car, lest the heat radiated from the bodies of the occupants might in some degree affect their correctness. Many of them were specially designed for the purposes of the trip. The balloon was inflated with hydrogen, nominally pure, but, as the smell which it left in the gas-bag showed, it was still some little distance removed from the odourless gas which the chemists define.

"Hydrogen is, of course, the most expensive, but its lifting power is double that of coal gas, and therefore it was selected for this trip. Coal gas will lift about 35 lbs. per 1,000 cubic feet. Hydrogen lifts 75 lbs. to 80 lbs.* Its use gets over one of the chief difficulties of ballooning. If you have coal gas, you must fill your balloon very full, and carry a lot of ballast. The reason is that it is impossible—and it is in this point, I think, that Andree went astray—to keep a balloon at an even height. It goes up, the gas expands and escapes, and it immediately descends; then ballast must be thrown out to lighten it, and up it goes again; and this ascending and descending process is repeated continually at intervals of varying length. Now, with hydrogen gas half the quantity is required; so that you need only half-fill the balloon, and when it expands the loss is comparatively slight, and the adjustment, by throwing out ballast, is much less."

The last and most important feature of the equipment was two vessels containing oxygen gas. How they contributed to the success of the trip will shortly appear.

"We started at five o'clock in the afternoon," said Mr. Spencer, "and travelled in a south-easterly direction. This lasted until we attained a height of 10,000 ft., and we did not like it because we saw the Sea Reach, at the mouth of the Thames, ahead of us (if one can say so, when it was so much below us), and we did not fancy descending into it, although we had lifebuoys with us. However, after 10,000 ft. we got into another current travelling south-west. It was a lovely day, and the air was extraordinarily clear. Usually, when one makes an ascent, one finds the view obscured by clouds; but on Thursday, at 23,000 ft., we could see the coast of France, along the east coast of England to the Wash, and a great deal of the English Channel, with dots on it for the steamers. It became dreadfully cold after this, but we were prepared with heavy woollen clothing, and particularly with wrappings for the legs, for they are shaded from the sun by the sides of the car, and usually suffer most. Still, in spite of our precautions, we were both shivering with cold. At 25,000 ft. the air was so rarefied that I began to become giddy, and had an indescribable sensation of asphyxiation. I looked at Dr. Berson who was busy at the instruments, and he was making a gurgling noise as he breathed. 'Oxygen!' he gasped, and so I handed him a tube which led from one of the oxygen vessels, and took another myself, and we put them in our mouths and sucked at them. The effect was marvellous, and instead of feeling exhausted, we felt quite exhilarated. At 27,000 ft. we had only four bags of ballast left, and they were necessary to ensure a safe descent. So, after registering another 500 ft., I pulled the valve-rope, and down we came. At the highest point I removed the oxygen-tube from my mouth for a moment, and at once the suffocating feeling seized me: but when I replaced it I recovered immediately. I feel confident that with a good supply of oxygen for breathing purposes we could go a great deal higher than has ever been done yet."

"How high is that?"

"Well, I am inclined to think that our ascent

* (?) 65 to 70 (Ed. *Aer. Jour.*).

Digitized by Google

was really the 'record.' I know that Glaisher and Coxwell reported that they recorded 29,000 ft., but after my experiences recently, I doubt it. I have been ballooning all my life, and may reasonably be supposed to have become accustomed to rarefied air; and Dr. Berson also has had much experience. Now, we both found asphyxiation become severe at 25,000 ft., and would certainly have been unconscious before 27,500 ft. but for the oxygen gas. Glaisher and Coxwell had no oxygen, and I really can't see how they could either of them have been conscious at 29,000 ft. I think that some error must have been made."

"We came down at Romford all right. We got a decent bump," said Mr. Spencer cheerfully, "but no harm was done. I may say that when we landed there was not sufficient gas in the balloon to keep it up. The first part of the descent was very rapid, so rapid that we let go our ballast. We had it in bags over the side, fastened at top and bottom, so that when we cut the string at the top the bag fell over and emptied. When the sand fell out, however, the particles were caught by the air, and the result was that, although it passed out of the bags, we were descending faster than it was, so that it seemed to go up, and as you will see presently, a good deal of it stuck to the varnished exterior of the balloon. The bags, too, when they were lightened of the sand, floated up until the balloon slackened its downward pace. It is worth noting that at 18,000 ft. as we were ascending, the balloon, which had been rather more than two-thirds inflated, was fully expanded, and at 22,000 ft. we lost a considerable amount of gas."

"Did you feel the loss of strength that Glaisher and Coxwell experienced?"

"Yes; it was quite astonishing. Our strength seemed to be quite gone. It was in view of this that we had fixed the sandbags as I have described, so that we could cut them loose. We might not have been able to lift them over the side."

Dr. Berson's High Ascent.

The following letter appeared in the "Daily News" of September 27th.:—

Sir,—Your numerous readers must have felt rather surprised when they read your able article in the "Daily News," of September 16, that "Dr. Berson claims to have already risen to an altitude of seven miles, or one mile higher than the awful record of Mr. Glaisher and Mr. Coxwell, when both were within an ace of perishing."

That we did attain the seven mile elevation has been accepted and recorded for the past generation by the most distinguished Fellows of the Royal Society, and by the Committee of the British Association, none of whom ever disputed the recorded observations by Mr. James Glaisher (a Fellow of the Royal Society) until Mr. Stanley Spencer assails his reputed veracity, and my own as well, by saying to the interviewer of a morning paper that his ascent with Dr. Berson from the Crystal Palace "was really the record," and "he knew that Glaisher and Coxwell reported that they reached 29,000 feet. But after my experience," continued Mr. Spencer, "I doubt it." So because he and Dr. Berson found asphyxiation becoming severe at 25,000 feet, Spencer rashly inferred that we could not have reached even 29,000 feet, and thought some error must have occurred.

Now although Mr. Glaisher was insensible for 13 minutes, the index of his minimum self-registering thermometer had been left at minus 11.9 degrees and this gave a height of 37,000 feet, fully seven miles.

I also, when on the hoop to let off gas for our descent, read a specially constructed aneroid barometer, which recorded the height at that time as seven miles.

Mr. Stanley Spencer, whose figures as to his own elevation are in all probability correct, places Dr. Berson's claim, if the meteorologist really said so, on the horns of a dilemma, for if the doctor had to cry out for oxygen while he was making a gurgling noise as he breathed at 25,000 feet over British soil, how did he manage in Germany to get seven miles, or 37,000 feet, without ceasing to breathe altogether?

But no doubt the learned doctor will fully explain all these matters, and will regret that he had not stipulated for silence on the aeronaut's part, and thus have his first say on debateable points, though how he could have managed to go 10,000 feet higher in Berlin than he achieved in England, after being nearly suffocated before he had got five miles up here, shows that his lungs and heart were not in such bad condition after all. The picture, however, as portrayed by the enterprising young balloonist, does not promise well for an extra two miles excursion upwards. Still, the respective disclosures by the scientist and the aeronaut, if they lack complete agreement, will prove edifying, and doubtless the dauntless professor

Digitized by Google

will put everything right when his personal account appears in print. — I remain, your obedient servant,

HENRY COXWELL.

Seaford, Sussex.

Some Balloon Record

There has been considerable discussion in the papers with regard to Dr. Berson's recent high ascent, and as to the real record height attained by a balloon. We therefore recapitulate a few facts bearing on the subject.

Herr Mullenhoff, of Berlin, classified ascents into those in which the elevation was measured with certainty, and those in which there was only a reasonable estimate. As, however, his figures vary somewhat with those given by Glaisher in his "Travels in the Air," the latter are also appended:

OF THE FIRST CLASS—

	Feet (Mullenhoff)	Feet (Glaisher)
Welsh, Nov. 10, 1852 ...	22,700	22,930
Guy Lussac, Sept. 16, 1804	22,800	23,000
Barral and Bixio, June 26, 1850	22,876	—
Glaisher, June 26 ('63?), and Aug. 18, 1862 ...	23,100	(23,000 (24,000
Sivel, Crocé-Spinelli, Mar. 22, 1875	23,720	—
Glaisher, April 10 (18?), 1863	23,720	24,000
Glaisher, July 17, 1862 ...	25,753	22,357
Glaisher, Mar. 31, 1863 ...	—	24,000
Gross and Berson, May 11, 1894	25,840	—
Tissandier, Sivel & Spinelli, Apr. 15, 1875	27,950	—
Glaisher, Sept. 5, 1862 ...	28,723	29,000
Berson, Dec. 4, 1894 ...	29,740	

OF THE SECOND CLASS HE GIVES—

Green, Sept. 27, 1836 ...	24,150	—
Mme. Blanchard, April 26, 1809	24,700	—
Hobard, Oct. 9, 1835 ...	25,784	—
Garnerin, Oct. 3, 1803 ...	26,600	—
Green and Rush, 1838 ...	26,871*	—
Cosmachi, 1842	27,542	—
Andreoli, April 22, 1808 ...	32,500	—
Glaisher, Sept. 5, 1862 ..	35,800	37,000

* Rush, in his "Account of Ascents," published in 1851, mentions only two ascents this year, of respectively 9,185 feet and 20,352 feet.

Small balloons with recording instruments have ascended over 60,000 ft.

As regards sojourns in the air:—

Andree, with a guide-rope, had been just upon 48 hours in the balloon at the time of dispatching his pigeon message.

M. Mallet in 1892 maintained himself for 36 hours in the air.

M. Hervé, on September 12, 1886, left Boulogne at 6.30 p.m. remained 24 hrs. 30 mins. in the air, and descended in the sea off Yarmouth.

The Great Leipzig balloon, on October 19, 1897, remained up with eight passengers for 24 hrs. 15 mins., during which time it travelled some 1,032 miles, probably the longest balloon journey ever made. Testu Brissy made a journey lasting 23¾ hours.

On March 25, 1875, M. Gaston Tissandier left Paris at 6.20 a.m., and descended in the Landes at 5 o'clock next morning.

Wise and La Mountain, in July, 1859, travelled from St. Louis to Henderson, N.Y. (850 miles) in 19 hrs. 50 min.

The "Great Nassau" balloon, on November 7, 1836, travelled over 500 miles to Weilburg, in 18 hours.

"Le Geant," in 1863, left Paris with nine persons, and made a very rough descent near Eystrup, in Hanover, after about 18 hours spent in the air.

On November 24, 1870, two aeronauts escaping from besieged Paris, landed in Norway, about 825 miles distant, after being 15 hours in the balloon.

The largest number of passengers taken in a free balloon trip was on November 17, 1889, when 20 persons (including four ladies) ascended in the great balloon (107,000 c. ft.) which had been used captive at the Paris Exhibition.

The balloon used captive at the Paris Exhibition of 1878 was the largest ever made, containing 883,000 c. ft., and could carry 52 passengers to a height of 1,640 ft.

The London captive of 1859 had a capacity of 350,000 c. ft.

The Paris captive, of 1889, made 1,121 ascents, and carried up in all 13,109 persons, including 2,499 ladies.

Andree's Polar balloon contained 162,000 c. ft.

As regards speed, though many statements have been made of greater rates, the highest well authenticated was that of De Fonvielle and Tissandier, in February, 1869. Ascending from Paris at 11.35, they reached an altitude of 3,280 ft., and in 35 minutes descended at Neuilly St. Front, which is 48 miles from Paris. They had therefore travelled at the

Digitized by Google

rate of 90 miles an hour. De Fonvielle again leaving Paris in 1870, reached Louvain in two hours, which gave a mean speed of 88 miles per hour.

Simmons, on June 10, 1882, left Maldon at 12.45, and, crossing the Channel, landed at 2.35 seven miles beyond Arras, the distance being about 140 miles (77 miles an hour).

Messrs. Green and Rush, in 1838, ascended to a height of two miles in seven minutes (25 ft. per sec.). Messrs. Coxwell and Glaisher descended on one occasion two miles in four minutes.

For number of ascents, the palm must probably be given to Charles Green, who made nearly 1,400 ascents. Coxwell has unfortunately kept no record. P. Spencer has made over one thousand. Louis Godard, last year, had made 625 free ascents. Wise made about 500, and Simmons 493.

A balloon used by Green made over 256 ascents.

Further Experiments in Flight.

By Major Moore.

I have been trying some further experiments for free flight with my clockwork model, as illustrated in the October, 1897, number of the "Aeronautical Journal." I find that by using the springs which I advocate for taking the strain of the wings, the model will fly a short distance, whereas, if I do not use the springs, the model will move forward only when running on a wire.

This proves that what I say about using springs like pectoral muscles is correct as described in my specification, No. 6, of 1895.

The springs store up the energy of the upstroke of the wings to increase the energy of the down-stroke

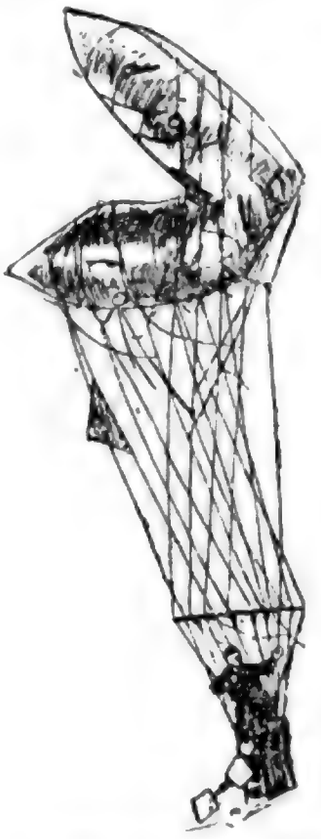
Many who are studying the subject of flight, realise the reciprocating action between the power and weight of the machine, when flapping wings are used, but have got into difficulties, like Mr. J. Marshall, through not using my springs. This they are welcome to do for experimental purposes, and I would willingly give them all information about them as far as in my power.

R. F. MOORE.

August 6, 1898.

A New Dirigible Balloon.

On the 20th September, M. de Santos Dumont ascended from the Jardin d'Acclimatation, Paris, in a balloon of his invention. It was of a long cylindrical form with conical ends, being 83 ft. long and 12 ft. diameter, constructed of fine Japanese silk by M. Lachambre. It had a capacity of 6,500 c. ft., and contained a compensating "ballonnet" of 880 c. ft. Two automatic valves regulated the pressure of the gas and the air respectively. On each side of the



[Illustration from *The Sunday Chronicle*

balloon was arranged a long horizontal pocket to contain battens of wood each a foot long. To the centres of each of the battens were fixed the suspension cords, this system doing away with the necessity of a net. For extra security bands were sewn over the upper part connecting the two pockets. The car, of basket work, was suspended from a horizontal steel bar, at a distance of 30 ft. below the gas vessel. The total weight of the apparatus was 130 lbs.

Attached, outside the car, was a small petroleum motor, formed of two superposed Dion-Bouton cylinders, of the same type as those used for motor tricycles and giving about 3 to 3½ horse power. The propeller consisted of an aluminium screw only 32 inches diameter, but

Digitized by Google

making 1,000 to 1,200 revolutions a minute. The weight of the motor, with screw, petroleum, etc., was 175 lbs.

At a quarter past four the balloon, inflated with pure hydrogen, ascended with the inventor, when it at once circled several times around the large captive balloon in the grounds, and then was directed towards the Bois de Boulogne at an altitude of about 600 ft., making several circles of about 100 yards radius. Soon, however, M. de Santos-Dumont had to stop the engine on account of the unsatisfactory working of a pump to drive air into the compensator, and the balloon lost its rigidity, and descended. It partially collapsed (as seen in the illustration) and fell rapidly to the ground. The aeronaut, though slightly shaken, was not much the worse, and has announced his intention to give the apparatus another trial.

*The Kite Equipment of the Arlington Observatory.**

Washington, Sept. 2, 1898.

Just outside of the city, about a mile from the old Lee home, at Arlington, Va., the Weather Bureau has established a kite farm, and is making experiments in the use of kites for weather observations. This aerial observation station is one of sixteen under the direction of the Bureau. Others are located at Cincinnati, Omaha, Topeka, Knoxville, Pierre S. D., Duluth, Cleveland, Cairo Ill., Sault de St. Marie, and Little Rock. Professor C. F. Marvin, who is in charge of this work, believes that valuable results can be obtained by the kite observation system, and has invented a number of devices for handling and managing the immense kites used at the Arlington station. One drawback to the use of kites has been the difficulty of controlling the big seven-foot affairs employed to carry the observing and recording instruments used in meteorological work. To cope with this difficulty Professor Marvin has built a new kite controlling machine, which makes it possible for one person standing before the reel to have within reach all the controlling handles, and to read the dials showing the amount of line run out, the pulling power of the kite, its elevation, distance, and electric connections.

As a further convenience, the kite is provided with a Shipman four-horse automatic oil-burning engine, to furnish power for pulling in the kite. The throttle of the engine is also within easy reach of the operator, so that the steam power can be applied instantly, and in case of an emergency the kite can be brought down rapidly.

The improved Hargrave kite is used almost exclusively for the regular observations, although experiments with new forms are still being made, many having curious shaped cells, some with divergent ends, wings, tails, and other queer appendages. The average size is seven feet long, six feet wide, and three feet high, the forward cell having a central horizontal division or intermediate supporting plane. Steel piano wire, 30-1000ths of an inch in diameter, weighing fifteen pounds to the mile, and capable of sustaining a tension of 300 pounds is used for kite-string. This is none too heavy, as in strong winds the pulling power of these kites frequently reaches 120 pounds or more. To have a kite fly away with the expensive instruments which it carries would mean a considerable loss, and the operators do not run the risk of sending the kites up in very heavy winds. The reel carries 20,709 feet, or nearly four miles of wire.

The ease with which Mr. Potter, who is in charge of the Arlington station, is able to handle his kites is at once apparent to the visitor to his kite-farm. Only a slight breeze is required to make an ascent. The kite is released and allowed to float some distance by unloosening the strap friction-brake which controls the reel. By applying the steam power, the kite is rapidly drawn in a considerable distance and soars skyward instantly. By repeating this operation several times the engine enables the meteorologist to send up a kite rapidly and without exertion.

As the wire unwinds from the reel, it passes down and around a pulley-wheel, thence up again, over a swivel-pulley wheel to the kite. The swivel-wheel turns on ball-bearings and adjusts itself to the direction of the kite, while the pulley-wheel below rests on springs or scales, registering in pounds the pulling power of the kite on a revolving drum or dynamometer before the operator. Mr. Potter has before him, on the machine, two indicators to show how much wire is released. One counting dial is attached to the swivel-wheel, and the other is operated by the revolution of the reel, so that the calculation is quite accurate. By means of a radius rod and arc, the inclination of the wire at the reel is determined, The radius rod is clasped upon the axle of the swivel-wheel, and by turning it around to meet the kite-line, the angle may be read on the arc. By reference to a tabulated chart, the observer

* By courtesy of the S. S. McClure Co.

Digitized by Google

can tell the exact height of the kite from the ground, knowing both the angle and the amount of line out. A theodolite and a nephoscope are also kept for determining accurately the height of ascents. The machine is even fitted with a guide to prevent the wire from being wound irregularly on the reel. This guide is automatically moved from side to side, and winds the wire with perfect regularity. The entire apparatus, with the engine and gasoline tanks, rests on a solid platform, and when not in use is protected by a wooden covering.

The great advance that has taken place in the aerial observations of the Weather Bureau is shown by the wonderful development of the recording instruments. Formerly a separate instrument was made for recording each of the conditions of the weather. Now an instrument has been adopted which performs the work of four separate machines, and is lighter than any one of the former instruments. The meteorograph, as it is called, records automatically, the humidity, barometric pressure, the temperature of the air, and the wind velocity. A record sheet, printed in four divisions for the varying degrees of humidity, barometric pressure, temperature and wind velocity, and divided up for the twelve hours of the day, is fastened around a drum, which, operated by clock-work, makes one revolution in twelve hours. It is upon this moving record sheet that the meteorological changes are indicated by the action of four delicate inking pens.

In preparing the instrument for use, the thermograph pen, which is operated by a special quicksilver tube, is adjusted to the line on the sheet to correspond with the surface temperature — that is, the pen point is lengthened or shortened to the point of the correct temperature mark. The humidity pen is then adjusted to agree with the percentage of humidity as determined from the readings of the sling psychrometer, by extending the pen to the proper point. In the same manner the pressure pen, recording barometric pressure, is set to the right point on the record sheet to agree with the reading of the barometer. The wind pressure indicator, of course, starts at the zero point. Each of the indicating mechanisms are made as simple and as light as possible.

With all the indicators set exactly, the meteorograph is put inside a thin covering, which is attached to the kite in such a position as to allow the air to pass through an open cylinder, in which it acts upon the recorders, and the pens mark out the changes. As the kite ascends, the clock-work slowly turns the record sheet, and the pens leave waving lines, which indicate precisely the conditions in the surrounding atmosphere as long as the observation lasts.

It is noticeable that all four records correspond with each other somewhat in movement. For instance, as the velocity is greater the temperature rises simultaneously, and a corresponding change takes place in humidity and barometric pressure.

At the sixteen stations, these records are made daily when the weather is favourable, and the record sheets are forwarded to the Weather Bureau, where they are studied, new facts regarding aerial conditions are learned, and the records kept for reference. One of the most interesting results is the forecasting of cold and warm waves. Such changes in the weather are found to be apparent at a great height long before they reach the earth, and kite records have shown the approach of a change fully twenty-four hours in advance of its first symptoms at the surface.

The dangers of the use of wire in flying kites to great heights can readily be understood. There is always more or less electricity on the wire, and the large amount of steel used in the new operating machine makes it dangerous to touch the reel at all. A ground connection is made to carry the current from the wire some distance away from the point of operation. Mr. Potter has a switchboard on his instrument, so that he can also direct the current from the wire to his kite house, for the purpose of making experiments with the atmospheric electricity produced. A spark three-fourths of an inch in length is often produced. In a number of cases, a storm coming up while a kite was up has done considerable damage. Recently at one of the stations, twelve thousand feet of wire were burned by lightning, and all the operator saw was a line of smoke extending up to the kite. Mr. Potter has two large kite sheds, in which are kept the newest designs of experimental kites, and instruments of various kinds used in the work.

The landing of a large kite is sometimes a difficult matter, when the wind is gusty and erratic near the surface. What is known as a landing line is generally used. When the kite is about 150 feet distant, an aluminium landing pulley attached to a line is slipped over the kite-line, an assistant follows the direction of the kite, drawing the line down until he is directly under the kite. He moves from side to side with the action of the kite, drawing the line nearer, until, when the darting motion of the kite has eased up, he draws it quickly to the ground.

Digitized by Google

The Arlington kite-farm being near Washington, is easy of access for the members of the Weather Bureau, who are at the head of the observatory system, so that the work of this station is being developed rapidly. Printed instructions and reports of the experiments and achievements throughout the country are sent from time to time to all the stations. The professors are deeply interested in the results of the study, but they realise that as yet comparatively little is known of the conditions of the upper atmosphere, and are confident that the researches being conducted by the Bureau will be productive of valuable results.

ALBERT B. LYON.

NOTES.

New Kite Record.—Blue Hill, Aug. 26.—The world's record for high kite flight was broken this afternoon at Mr. Rotch's observatory by Messrs. Clayton and Fergusson, who dispatched a tandem of kites into the air until the highest one reached an altitude of 12,124 feet above the sea level, a height 360 feet greater than any kite has reached heretofore. The top kite was of the Lamson bird pattern, and had an area of 71 sq. ft. The other kites were the modified Hargrave box variety, and had a combined area of 149 sq. ft. All the kites were fitted with self-regulating, elastic bridles, invented at the observatory, to prevent the kites from exerting a dangerous pull. Five miles of line, weighing 75 lbs., was let out, while the weight of the kites, recording instrument, and secondary line, was 37 lbs., making a total of 112 lbs. lifted into the air. The recording instrument was made by Mr. Fergusson, of aluminium, weighing 3 lbs., and registering temperature pressure, humidity, and wind velocity. The ascent was begun about 11 a.m., and the highest point reached at 4.15 p.m. The kites were drawn in by a steam windlass, and the last one reached the ground before 9 p.m. The kites passed through clouds when about three-quarters of a mile above the surface of the earth, and while above the clouds the hygrometer showed the air to be very dry. At the highest point, the temperature was 38 degs., and the wind velocity 32 miles an hour. At the ground, at the same time, the temperature was 75, and the wind velocity 22 miles. The highest wind velocity recorded was 40 miles an hour at a height of 11,000 ft. The wind on the ground at this time was from the west, while at the highest point reached by the kites it was W.S.W. The flight to-day was one of a series of high ascents made during the spring and summer, averaging about a mile and a half, while on several occasions, a height of over two miles has been attained.

An Aerial Ship.—Professor Giampietro, of the University of Pavia, has designed an aerial ship, consisting of an immense hollow cylinder of aluminium, like a cigar in shape, and rigged above like a three-masted sailing ship. There are also aeroplanes, or rather great wings, and aerial screws projecting from the sides. A car is hung underneath. The sails on the masts are for driving and steering the vessels, the side wings for rising and sinking without the use of ballast. The side screws are also for propulsion and steering.

Balloons in the Spanish-American War.—But few details have been published regarding the American War Balloon, which ascended near Santiago during the recent fighting. It is said to have afforded a most valuable means of reconnoitring, but it seems to have been shot down by the enemy's fire, a rather unexpected result considering that such an eventuality has hitherto been thought unlikely, and the Spanish shooting was not conspicuous at other times for its accuracy.

A Duchess as Aeronaut.—From Vienna we learn that the Duchess of Aosta, a daughter of the late Prince Jerome Napoleon, is an enthusiastic aeronaut, and considers ballooning the most suitable high society sport. The duchess is now staying at Arco, and has hired a balloon for a month, besides engaging two aeronauts to initiate her into the mysteries of ballooning. It is said that she makes an ascent every day, accompanied by her maid. She has ordered a balloon of her own, and at the expiration of the month intends to undertake some longer trips. Ballooning, she declares, is far superior to mere yachting, and must inevitably become the sport of the aristocracy.

Aeronautics at the British Association.—In addition to the paper on "Balloons for Geographical Research," which is reproduced elsewhere, the following papers bearing on the subject were read: — Mr. Eric Stuart Bruce, in a paper on "The Use of Electric Balloon Signalling in Arctic and Antarctic Expeditions," dealt with the system of electric balloon signalling, invented by himself, which has already been described. The apparatus consists of a balloon, made of a translucent material and filled with hydrogen or coal gas, in which are placed several in-

Digitized by Google

candescent electric lamps in metallic circuit with a source of electricity on the ground or the deck of a ship. In the circuit on the deck is an apparatus for making and breaking contact rapidly, and thus, by varying the duration of the flashes of light in the balloon it is possible to signal according to the Morse code. Mr. Bruce claimed that his electric balloon had been successfully manipulated not only in fair weather but in half a gale, a snowstorm and mist. Regarding the distance to which signals might be transmitted, he thought it reasonable to expect that, given a sufficient altitude a high candle power, and a clear atmosphere, through a telescope the flashes would be visible some 80 or even 100 miles. A communication from Dr. A. Lawrence Rotch on the "Exploration of the Upper Air by Means of Kites at Blue Hill Observatory, Mass., U.S.A.," was read by Dr. Howard. Since the last report presented at Toronto great progress has been made in the work. The Hargrave kite has been perfected by making it larger, more rigid, and relatively lighter, and by concaving the surface exposed to the wind the vertical component of the latter has been increased. In general, these kites, with a short line, rise from 50 to 60 degrees above the horizon, and pull about one pound per square foot of lifting surface in a wind blowing 20 miles an hour. Elastic bridles diminish the angle of incidence of the wind as its pressure increases, and thereby enable the kites to fly in gales. A meteorograph made by Mr. Fergusson, which records the pressure, temperature, and humidity of the atmosphere and the velocity of the wind weighs but three pounds. Since the use of wire and more efficient kites the mean height of the flights has been increased to more than 7,000 ft. during the past few months. On six occasions 10,000 ft. was reached, the maximum altitude attained being 11,440 ft. on August 26, 1898. Mr. Douglas Archibald said he had first begun meteorological observations with kites in 1884, and he attached considerable value to their use for many purposes. Kites could support considerable weights, and transfer them from place to place. He was at Blue Hill Observatory, Massachusetts, some time ago, when the kites were flying at a height of 7,300 ft. The connecting wire broke and a box containing instruments was seen to be soaring away so far into space that it could only be distinguished by a telescope. A bicyclist, however, rode hurriedly off in the direction taken, and was fortunate enough to find that the instruments had been gently dropped, absolutely uninjured at a distance of six or seven miles. The kite-balloon combination, such as was now used in Germany, suited the two conditions of wind and calm. Kites could be used very advantageously for photographing from great heights either unknown country or the position of an enemy. Some of the officers in the Tirah campaign had said that with kites they could have photographed the enemy's position. Aerial reconnaissance was one of the coming features of warfare. A small kite could take up a greater weight to a greater height than any balloon.—Thanks were voted to the readers of the papers.

Narrow Escape of a Parachutist.—Carelessness and inexperience once again nearly caused a catastrophe. The "Morning Leader" reports: "It was at Mussourie, in the Deccan, where a young man was making his first ascent, and when about 100 ft. from the ground the balloon burst from top to bottom. 'Let go!' was yelled from below by a hundred throats, and the young man had the presence of mind, though flying through air, to detach his parachute. It was an anxious moment. A discordant yell went up from the assembled multitude, and shrieks in various keys from the ladies. Everyone expected to see the unfortunate man killed or seriously injured; but when about 10 ft. from the ground the parachute opened, and he landed fairly easy. In inflating the balloon the flames had gone too high and charred the cloth.

To Paris by Balloon.—Mr. Arthur Williams has announced his intention of shortly attempting a balloon voyage from London to Paris. He will be accompanied by Mr. Brewer and a reporter. It is said that "he does not mean to try any steering apparatus, only to start with a favourable wind." If so, he may have to wait a very long time, and, moreover, if he gets his favourable wind to start with, it is extremely doubtful how long that will continue.

The Aerostatic Railway.—The most remarkable railway in the world has for its motive power not steam or electricity, but a balloon. Stranger still, the official stamp of approval has just been put upon this most marvellous railroad, which goes to and from the summit of Hochstauffen Mountain, at Bad Reichenhall, the well-known watering place in the Austrian Alps. The Aerostatic Railway—to give it its correct designation—owes its inception to the well-known inventor, Herr Volderauer, who had long convinced the experts that his scheme was perfectly feasible and safe. A single rail guides the cars, and keeps the balloon with its load captive, the cars gripping the rail at the sides and underneath the flange. At about every 15 ft. the line is firmly anchored.

In descending the mountain, of course, gravity is the propelling force, water ballast being taken on board at the upper end to counterbalance the buoyancy of the balloon. The cock on the water-tank of the car can be opened by the operator at any time. The tank carries about 800 lb. of water, and the tank and car together weigh about 600 lb. The balloon is 67 ft. in diameter, and exerts a lifting capacity of something over 11,000 lb. Weights also can be taken on board and discharged at the various stations along the line. At the foot of the track are the gas tank and generator. The summit of the Hochstauffen offers a sublimely beautiful view; but before the advent of the Aerostatic Railway the climb was both long and tedious. It was only attempted by experienced mountaineers. — "Invention."

Liquefied Gas for Ballooning.—Now that we can carry light gases, such as hydrogen and coal gas, in the form of liquid, it is probable that a new departure will be made in ballooning, either in the shape of gas motors for propelling the balloon, or to increase the ascensional force. The liquid gas can take the place of ballast. Professor Errera, of the University of Brussels, proposes to surround the balloon with a kind of collapsible life belt or buoy, which can be inflated or emptied of gas at will by means of pipes and stopcocks communicating with the bottles containing the liquid gas or with the open air. To ascend, the gas would be let into the buoy, and to descend it would be let out. With a good portable machine for liquefying the gas it could be brought back to the liquid form and restored to the bottles.—"Globe."

Foreign Aeronautical Periodicals.

L'Aeronaute (Paris).

Juillet, 1898. No. 7.—Lettre du Comité de l'Exposition de 1900 et rapport du secrétaire de la Commission—Société Française de Navigation Aérienne. Séance du 5 Mai, sous la présidence de M. Radau; Séance du 2 Juin, sous la présidence de M. Triboulet—Séance du 16 Juin, sous la présidence de M. Radau—Compte rendu aéronaute de divers journaux français et étrangers—Lettre de M. Variclé—Souscription pour le médaillon de M. Hureau de Villeneuve—Ecole Française de Navigation Aérienne: Ascension du 7 Aout 1898 et convocation aux élèves volontaires.

Aout, 1898. No. 8.—Exposition de 1900—Composition des Sous-Commissions et liste alphabétique des membres du Comité avec indication de leurs fonctions—Société française de Navigation aérienne—Séance du 7 juillet (Assemblée générale).—Compte rendu aéronautique de divers journaux français et étrangers—Recettes et procédés: Pégamoïd, Ripolin, Cellulose nitrée—La liquéfaction de l'hydrogène et les ballons, par M. Errera, professeur à l'Université de Bruxelles—Ecole française de Navigation aérienne, remise de l'ascension au 25 septembre prochain—Souscription pour le médaillon de M. Hureau de Villeneuve—Photographies—Ballon en aluminium de MM. Sibillot et Vernanchet—Les élèves et les professeurs de l'Ecole française de navigation aérienne. 1re section sur le terrain (Pratique).

September, 1898.—Projet de lignes de ballons par M. de Poulpiquet—Laçon ana élèves de l'Ecole (M. Hauvel)—En ballon dirigiable MM. Santos-Dumont et Debayeux—Observations de MM. Charles Sibillot, de Fonvielle et Mallet—Faits divers.

La France Aerienne (Paris).

1er au 15 Juillet, 1898.—Bulletin météorologique mensuel.—Jurisprudence colombophile: A propos des déclarations antérieures à la loi de juillet 1896—Parachute dirigeable: système Carelli préconisé par M. Vialardi; appréciation de M. Jobert (avec dessins)—Le calendrier du colombophile—Inauguration d'un colombier maritime à Rochefort-sur-Mer—Flagrante delicto—Louet: Ascension de la Ville-de-Corbeil—A la volée—Tribune libre: Lettre de MM. Aphone et Loy—Correspondance—Revue de presse—Académie d'Aérostation Météorologique de France: Séance du 1er Juin 1898.

15 au 31 Juillet, 1898.—J. Maret-Leriche: A propos du Congrès de 1900—Colombophilie militaire: L'internement des Pigeons voyageurs—C. Jobert: L'aviateur mixte de Louis Roze—Tribunaux. Colombophilie judiciaire: Gigot contre Rosoor-Delattre. Condamnation de ce dernier—Le Messager angevin. Distribution des récompenses—Les Voltigeurs de l'Est; Fête annuelle—A la Volée.

Supplément: Variétés. Emile Cruchet: Propos du Jour—Correspondance: Lettre de MM. V. Rouma et Loy—Revue de presse: The aeronautical journal. Sommaire 1898—Le premier voyage aérien, pièce historique de Louis Figuier (suite).

Digitized by Google

1er au 15 Aout, 1898.—Bulletin météorologique mensuel—Docteur Ox: Un an après—Calendrier colombophile—A. Huard: Byzance—L'aéronautique au jour le jour: direction verticale des ballons, système Tival—Le Messager rochefortais—A la volée La Fête nationale en province: à Lyon, Vienne, Roanne, la Bassée, Lille—Variétés: Le premier voyage aérien (suite).

15 au 31 Aout, 1898.—Docteur Ox.: Herr Bismarck—La Colombophilie au jour le jour: A propos des juniors, E. Caillé—E. Tincelé: Exposition d'aviculture—A. Huard: L'Avion-Ader—L. L.: L'Eclair de Talmont—A la volée—Revue de presse: Essais avec le ballon cerf-volant météorologique de M. W. L. Moedebeck—Variétés: Le premier voyage aérien (suite et fin)—Tribune libre—Académie d'Aérostation Météorologique de France: séance du 20 juillet, 1898.

1er au 15 Septembre, 1898.—Bulletin météorologique mensuel—Tribulations pigeonnières: Docteur OX—Le calendrier du colombophile—La colombophilie en Vendée: Pigeon—L'aviateur Mixte: Carelli—L'escargot volant: A. Huard—Byzance: Maret Leriche—A la volée—Variétés—Propos du jour: Emile Cruchet—Aéronotique rétrospective—La chute du Montgolfier—Annonces.

Du 15 au 30 Septembre, 1898.—La colombophile a l'Exposition de Villemonble: Doctor Ox—Apropos du Congress de 1900: Maret Leriche-Etudes Aerienne; du vol de l'oiseau: E. Guinet—l'Aeronautique au jour le jour: C. Mathieu—A la volée.

L'Aerophile (Paris).

June, July, August.—W. de Fonvielle: Le docteur Hureau de Villeneuve—Alexandre Salle: Sejours prolongés daus l'Atmosphere—l'Exploration de la haute atmosphere a l'Academie des Sciences—A. Berson: les ascensions montees de Berlin—V. Cabalzar: l'Aeronautique à l'Exposition Universelle—Santes-Dumont: Une ascension au Jardin d'Acclimatation—Le ballon captif de l'Exposition de Turin—Ader: sur des apparils d'aviation—Le traversee de l'Afrique en ballon—W. Fonvielle: L'hydrogene liquide.

Zeitschrift fur Luftschiffahrt (Berlin).

June-July.—Die Internationale Aëronautische Conferenz zu Strassburg i. E. vom 31. Marz bis 4. April 1898 Kress: Ueber dynamische Luftschiffahrt mit Vorfuhrung freifliegender Apparate—Kleinere Mittheilungen: Milla, die archimedische Schraube in einfacher Darstellung—Zu Karos, „Ein Universal-Drachenflieger mit rotirenden Tragflachen"—Vereinsnachrichten: Milla, Carl Bosse—Wiener Flugtechnischer Verein. Protokolle der Plenarversammlungen vom 4. Januar, 18. Februar, 15 Marz und 15. April 1898.

August.—v. Parseval, Ueber das Segelproblem—Weisse, Ueber den heutigen Stand der Luftschiffahrt und die Einfuhrung von Flugapparaten nach dem Buttenstedt'schen Princip in unsere Verkehrs-Praxis—Deutscher Verein zur Forderung der Luftschiffahrt zu Berlin. Verzeichniss der vom Verein seit Juni 1897 mit seinen beiden Ballons „Sportpark Friedenau I und II" bis jetzt veranstalteten Vereinsfahrten—Vereinsnachrichten: Protokolle der Sitzungen des Deutschen Vereines zur Forderung der Luftschiffahrt vom 28. Februar, 28. Marz und 25. April 1898—Berichtigung.

Illustrirte Aeronautische Mittheilungen (Strassburg).

July.—Die Konferenz der Internationalen Aëronautischen Kommission zu Strassburg—S. A. Andrées Polarfahrt im Luftballon, von Dr. Nils Ekholm (Schluss)—Buttenstedt und die Flugfrage, von Arnold Samuelson—Die Luftschiffertruppe der I. franzosischen Rupublik, von Fingerhuth (Schluss)—Versuche mit dem meteorologischen Drachenballon, von H. W. L. Moedebeck—Neue Ideen, von A. Platte—Bericht uber eine wichtige Entdeckung, von Karl Steffen—Komprimirte Luft als neuester Ballast fur Luftschiffahrt—Zur Begutachtungsstelle von Entwurfen fur Luftfahrzeuge—Kleinere Mittheilungen—Aus unseren Vereinen—Aus anderen Vereinen—Patente in der Luftschiffahrt—Eingegangene Bucher und Separatdrucke—Zeitschriften-Rundschau—Aus anderen Zeitschriften—Neue Nachrichten—Todtenschau.

Notable Articles.

July 2. *Revue Scientifique* (Paris).—"Kites" (illustrated), also "Project for an Aerial Ship" (Giampetro's). (Illustrated)

2. *Golden Penny.*—"Balloons for Naval Operations." (Illustrated.)

28. *Daily Graphic.*—"Aerial Research." J. M. Bacon.

28. *Daily News.*—"Up in the Air—Scientific Ballooning."

Digitized by Google

July 29. *Daily Chronicle.*—"Science in a Balloon."
Aug. *Le Spectateur Militaire* (Paris).—"Meteorology and Ballooning."
3. *Commerce.*—"Mr G. L. O. Davidson." With portrait and illustrations of flying machine.
5. *English Mechanic.*—"To the North Pole in a Flying Machine—Balloon Navigation." E. E. Wilson.
13. *Golden Penny.*—"Atkins as an Aeronaut." Illustrated account of ballooning in the British Army.
18. *Nature.*—"The International Aeronautical Conference."
20. *Golden Penny.*—"Another Flying Machine" (Ader's). (Illustrated.)
20. *Revue Scientifique* (Paris).—"Across the Sahara by Balloon." L. Dex.
23. *Daily Graphic.*—"Echoes in the Air." Some observations from a balloon, by J. M. Bacon.
27. *Golden Penny.*—"Mr. G. L. Davidson's Dream of the Future." (Illustrated.)
Sept. *Forum.*—"The Balloon in Warfare." Prof. H Hergesell.
2. *English Mechanic.*—"Ballooning to the Pole." E. Wilson.
15. *Daily Mail.*—"Balloon Photography." (Illustrated.) Rev. J. M. Bacon.
17. *Daily Telegraph.*—"Notable Balloon Ascent," Dr. Berson's.
28. *Cassell's Saturday Journal.*—"Round the World in Eighty Hours."
30. *Daily Chronicle.*—"A Night in a Balloon."

Also many letters in *English Mechanic.*

Applications for Patents.

(*July, August, September*, 1898.)

14,618. July 2. H. S. F. Warth, 11, Burlington Chambers, New Street, Birmingham. **Improved Aerial Flying Machine.**

15,324. July 12. C. E. Hite, Norfolk House, Victoria Embankment, London. **Improvements in Air Ships.**

16,136. July 25. James Roots, 100, Westminster Bridge Road, London. **An Improved Aerial Machine.**

16,181. July 25 Max Lochner, 18, Buckingham Street, Strand, London. **Improvements in or Relating to Air Ships.**

17,395. August 12 W Cochrane, 67, Cadogan Square, London. **A New or Improved Flying Machine.**

17,654. August 16. W. H. Gilman, 45, Southampton Buildings, Chancery Lane, London. **Improvements in Aerial Conveyers.**

17,667. August 16. F. McLaughlin, 154, St. Vincent Street, Glasgow. **Improvements in Elevating and Propelling Devices for Air Ships.**

17,943. August 20. H. S. Booth, 1, Park Avenue, Southport. **Improvements in Aerial Machines.**

17,953. August 20. Edward Anderson, 70, Chancery Lane, London. **An Improved Flying Machine.**

18,219. August 24. Oskar Lange, 115, Cannon Street, London. **Improvements in and Connected with Air Ships, and in Means for Propelling and Steering the same.**

18,421. August 27. Gustav Koch, 6, Lord Street, Liverpool. **Improvements in Flying Machines.**

18,780. September 2. Thomas Moy, 8, Quality Court, London. **Improvements in or Relating to Means and Appliances for Effecting Aerial Navigation.**

18,896. September 5. L. W. Broadwell, Lydian House, Westbury Gardens, Clapham Park, London. **Improvements in Flying Machines.**

19,257. September 9. W. R. Smith and E. R. Smith, 117, Victoria Street, London. **Improvements in Apparatus for Flying.**

Patents Published.

From the *Illustrated Official Journal.*

3608. February 10, 1897. **Flying Machines.** Lanchester, F. W., Cobley Hill, Alvechurch, Worcestershire.

The improvements relate to projectiles as well as to machines for aerial navigation. The body is made with a stream line form, and is provided with fore and aft vertical fins or a single fin for steadying and directing the machine, and with wings or aeroplanes for supporting the weight of the machine and for directing it. The aeroplanes are built up of wire and tube framing with silk or sheet aluminium covering, or in small structures of a single piece of wood. The covering of the upper surface may be made less pervious to the air than that of the lower in order that internal pressure may aid in preserving the form. The aeroplanes may have vertical portions at the ends, and in that case are made shorter. When the machine is to be self propelled a motor drives a screw propeller having a continuous rim to serve as a flywheel and wire tension spokes, between which are fitted canvas or wooden blades. The form of machine to be used for navigation is shown in side elevation and in half front elevation. Two propellers are used, and are driven in opposite

directions by a gas or oil engine or a pair of such engines with oppositely rotating parts. A conical projection extends behind the rear propeller. A rectangular framework connects the various parts, and the fins are in duplicate, the rear fins being adjustable about vertical axes. The rear aeroplane is adjusted in inclination by cords from the occupant's car. The direction of motion may also be modified by the movement of ballast or of the occupant. In order to launch the machine or torpedo, two parallel wire ropes are employed as guides, the machine being held down by cord lashings till the moment of leaving the wire rope track, when the cords are severed by suitably placed knives. The initial motion may be given by a cable and winding engine or by a catapult arrangement.

5739. March 4, 1897. Flying Machines. MOLESWORTH-HEPWORTH, E. N., Holly House, Ashton-on-Mersey, Cheshire.

Four or more aeroplanes are mounted on cross yards, fixed to a central member. A framing suspended from the aeroplanes carries propellers and a car. The propellers are driven by the occupant by means of pedals and rope gearing or by a motor. A rudder is under the control of the occupant, and he can also adjust the relative inclination of the car and the aeroplanes by winding the rope on and off the shaft. The aeroplanes are concave, but are open in front, and have an extended serrated edge at the back; vertical longitudinal strips divide the under surface into several channels.

6320. March 10, 1897. Flying Machines. SIMMS, F. R., 12, Norfolk Street, Strand.

Refers to aerial machines described in Specifications Nos. 25,716 and 25,717, A.D. 1896. Propellers with blades of a uniform width of light material, increasing in pitch from the boss to the rim, are mounted on spindles, which are driven by bevel gearing and belts and from a pedal crank. The inclination of spindle may be adjusted by a handle for the purpose of steering. If wings are employed, only one propeller is necessary.

7012. March 17, 1897. Aerial Machines. DIESEL, R., Giselastrasse, 14, Munich, Bavaria.

To enable the cable supplying electricity from the ground to the electrically-propelled aerial machines to become longer or shorter as the machine is swayed by the wind, it is coiled on a drum at one end which is constantly tending to wind it up. The drum may be turned by an electromotor which is reversed by the pull of the cable when it becomes excessive, or the drum may be driven through a clutch which is thrown out of gear by an excessive pull on the cable, and into gear by a spring when the pull is diminished.

9734. April 17, 1897. Flying Machines. MARSHALL, J., 23, Rockingham Terrace, Birdwell, Barnsley, Yorkshire.

Refers to Specification No. 10,239, A.D. 1895. A cage carries one or more masts, each of which is provided with two pairs of wings and an aeroplane. The upper pair of wings is pivoted directly to the mast, and the lower to a sliding collar which is connected with the aeroplane so that the latter moves up and down with it. The wings and the aeroplane are actuated by a compressed-air motor which is supplied with compressed air by a pump in the car driven by a gas or oil engine. Each of the cylinders of the motor has two pistons working in opposite directions and working the wings simultaneously. Spring or india-rubber stops limit the strokes of the wings, and the lower pair with the aeroplane may be fixed in position by a catch. The valve regulating the action of the motor is driven from the arms of the wings. The wings and aeroplanes are concave, and have flexible steel tubular framing. The hollow masts, &c., serve as reservoirs for compressed air.

9864. April 20, 1897. Aerial Machines. BEENEN, B. R., Moritzstrasse, Dresden, Germany.

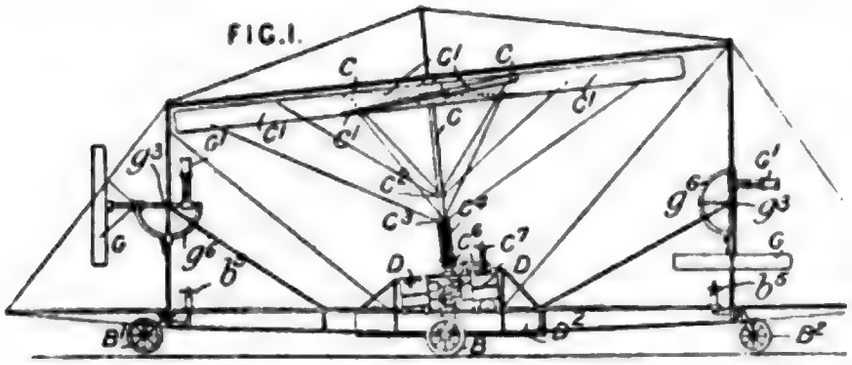
Two cars, a lower one for passengers and an upper one for carrying the motor, are provided with one or more lifting screws and horizontal propelling screws. The machine is steered by means of a fan mounted behind. The shafts of the lifting and propelling screws can be turned in a vertical plane so as to alter their inclination and to enable the propelling screws to assist in lifting; the shafts are held in any desired position by fixing the collars to a quadrant. The screws are constructed with a hollow conical centre to guide the air, and a ring fitted with vanes made concave on the pressure side and pivoted on radial bearings. The inclination of these vanes can be adjusted by a set of rods joined to a collar, the position of which can be regulated. The vanes can thus be reversed or made to form a continuous surface and act as a parachute in case of accident to the motor. The machine is provided with wheels and runners to facilitate starting and landing.

10,620. April 28, 1897. Flying Machines. MAXIM, H. S., 18, Queen's Gate Place, Middlesex.

The machine is supported and driven by two large screws, one on each side of the machine on nearly vertical shafts. One of these screws is shown in side elevation in Fig. 1. As shown, it is of small pitch, and has four blades C^1. Its shaft C is inclined forwards, and is driven by a four-cylinder steam or gas engine D. The blades of the screws are stayed so as automatically to diminish in pitch as the air pressure below them increases. The leading edges c of the blades are stayed to a fixed collar C^2, and the rear edges C^1 to a sliding collar C^3 attached by springs C^4 to a collar C^6, which can be adjusted to a suitable position by a hand-wheel C^7. The machine, when on the ground, rests on wheels B, B^1, B^2, of which B^1 and B^2 can be adjusted in height by hand-wheels

b^3. In addition to the large screws already described, the machine carries two smaller screws G, one in front and one behind. These are mounted, with their motors G^1, on frames g^6 turning on trunnions g^3 so that the screws may be used for either lifting, lowering, or propelling. The screw blades are of light pinewood strengthened by transverse strips covered with strong fabric, such as silk or linen, or they may be made with steel framework covered with strong fabric. In starting the machine it is run forwards, *i.e.*, to the left, until the screws C^1 assert their lifting effect. These screws act in the manner of aëroplanes or wings. The blade which is moving forwards is nearly horizontal, as shown in dotted lines, and offers little resistance to the air, but on its return it has a propelling effect. Rolling is counteracted by the automatic action of a weighted pendulum which, when the machine rolls to one side, cuts the supply of motive fluid from the motor D on the side which is higher, and opens wider the supply valve of the motor on the lower side. Fore and aft balancing is regulated by a sliding platform regulated by a hand-wheel. The motors D have four cylinders arranged in pairs opposite one another, and driving cranks at 180° so that, with a four-stroke cycle, an impulse is obtained every half revolution. The motors are preferably driven by acetylene, which is stored in reservoirs D^2 and is mixed with about one-fiftieth by volume of acetone or acetic ether or other suitable compound to produce a mixture which can be kept liquid at a lower pressure than acetylene alone. The tubular framing may be used for cooling jacketing-water or condensing steam.

FIG. 1.



10,811. April 30, 1897. **Aerial Machines.** FRICKE, G., Friedeburg a Saale, Germany.

The machinery is located in the space between the two buoyant chambers A and B. A hinged rudder carried at the rear can be manipulated from the chamber. Propellers mounted so as to be separately driven if desired, are carried on each side of the machine. By means of a pump air or gas may be made to pass from either A or B, or from B to A, through the pipe which may be connected to the atmosphere by a cock. D and E are air chambers similarly connected with one another and the atmosphere by a pipe, pump, and cock. The transference of air or gas from A and E to B and D, or *vice versa*, serves to steer the machine in an upward or downward direction as desired.

United States Patents.

606,942. August 9, 1897. **Flying Machine.** J. T. RICE, Hot Springs, Ark.

Elongated balloon, with numerous propellers mounted on shaft below.

606,960. January 24, 1898. **Kite.** JOHN DOYLE, Hoboken, N.J.

Kite constructed in the form of a boat, with sails, &c.

607,240. July 12. **Air Ship.** C. E. HITE, Philadelphia, Pa.

Elongated balloon.

607,129. July 12. **Kite.** S. A. POTTER, Washington.

Diamond-shaped box kite.

608,823. October 12. **Kite.** W. S. BAKER, Newark, N.J.

Ordinary diamond-shaped kite, pocket for backbone.

610,843. March, 1897. **Aerial Ship.** T. J. BROWN.

Body provided with series of independent gas cylinders propelled by screws.

French Patents.

274,316. PAJER. **Dirigible Balloon.**

275,401. ALAUX. **Apparatus for the Purpose of Aerial Navigation.**

275,602. DUSSEQUE. **Dirigible Balloon.**

276,035. METTRIER. **Aerial Propeller.**

276,134. COTTESSAT. **New Propeller for Aerial Navigation.**

277,157. MOLNAR and HORBIGER. **Machine to Fly in the Air.**

20.5
245

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4 19

THE AERONAUTICAL JOURNAL



No. 10. APRIL, 1899. Vol. III.

Contents.

	PAGE.
Notices of the Aeronautical Society	25
Meetings of the Aeronautical Society—Andree's North Polar Expedition. Percival Spencer	25
The Balloon as an Instrument of Scientific Research (*Illustrated*). Rev. John M. Bacon, F.R.A.S.	29
A Method of Steering Balloons During Ascent and Descent. D. Biddle, M.R.C.S.	37
How Birds Fly. H. N. Hugo	38
Wind Averages	42
Notes: Kite Flying Record—Sailing Balloons—Seventy Miles an Hour for 420 Miles—Descent in the Sea—Artillery versus Balloon—M. "Duruof"—A Model Air Ship—A New Balloon Gun—A Swiss Dirigible Balloon—Gyration of Aerial Machines	43
Recent Publications	45
Foreign Aeronautical Periodicals	45
Notable Articles	46
Applications for Patents—Patents Published—Foreign Patents, &c.	47

LONDON:

Published by the Aeronautical Society of Great Britain, and Printed by King, Sell, & Railton, Ltd., 12, Gough Square, 4, Bolt Court, and 4, Birchin Lane, E.C.

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCALLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

APRIL, 1899.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on March 6th, when the following gentlemen were elected Members:—

Mr. OLIVER FIELD.

Rev. J. M. BACON (re-elected).

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Meeting of the Aeronautical Society.

A meeting of the Aeronautical Society was held at the rooms of the Society of Arts, on Wednesday evening, 29th March.

Mr. C. F. POLLOCK was in the chair, and in opening the proceedings, called upon Mr. Percival Spencer, who he introduced as one of the best known aeronauts in England, to read the following paper on

ANDREE'S NORTH POLAR EXPEDITION.

Mr. SPENCER explained that most of the the details in this paper were extracted from the book entitled "Andree and his balloon," which was a very useful work, but in the English translation of it, many errors had crept in.

After the return of the Sir George Nares Expedition in 1876, the use of the balloon was suggested as a means of surmounting the obstacles in the way of reaching the regions of the North Pole.

My father—the late Charles Green Spencer—had a letter on the subject and a front-page illustration in the *Penny Illustrated Paper*, and subsequently Commander Cheyne suggested a scheme of reaching the Pole by means of triple balloons, which, however, never reached more than the theoretical stage, although he organized a subscription in this country and in America in order to carry it into effect. Other schemes have been suggested, and have appeared in the Press from time to time, but generally of a far too visionary and impracticable nature to be put into effect.

About 1894 the newspapers contained accounts of some balloon ascents in Sweden by Herr Andrée, on one of which trips he was blown across the Baltic Sea to Finland. It was shortly announced that he was contemplating an expedition with the idea of exploring the Polar regions by balloon. His scheme had the advantage of simplicity; he proposed to inflate a balloon with hydrogen gas as near as a ship could get, wait for a suitable wind, and then start with a view to crossing the Pole and continuing on until he reached inhabited regions on the other side. He proposed to keep the balloon near the surface of the earth by means of trail-ropes, so that he should be able to take observations in passing.

AN INTERVIEW WITH ANDREE.

In the summer of 1895 I saw Andrée in this country, and had an afternoon and evening's conversation with him on the subject of his proposed trip. He entered thoroughly into the matter. In connection with the use of the trail-rope in the Polar regions, my brother, who has been in Canada and witnessed the effects of the intense cold of a winter there, suggested that the rope was likely to freeze to the surface of the ground or ice and thus arrest the course of the balloon, to which Andrée at once replied that during the summer months at the Pole, the cold is not great, the sun is always up, and the temperature not below the freezing point, so that the surface of the ground remains damp and would never freeze to the rope. He pointed out that the constant sun and equal temperature was most conducive to the long duration of a balloon voyage. He had a very intelligent grasp of the subject of ballooning, discussed thoughtfully the various details of his equipment, and eventually adopted some of the suggestions I made in connection with his gear.

ANDREE'S FIRST EXPEDITION.

By the following year he had completed all arrangements of a financial and technical nature, and on the 7th June, 1896, embarked at Gothenburg on the steamer Virgo with balloon, gas apparatus, and

Messrs. Nils Strindberg, and Dr. Ekholm to be his companions in the car on the occasion of the most sensational balloon voyage ever attempted. The ship arrived at Spitzbergen on the 21st June. After a certain amount of exploring, a position on Dane's Island, adjoining the house erected by our fellow-countryman—the sportsman, Mr. Pike—was selected for the starting point, and the cargo was landed. A portable wooden shed, sufficiently large to protect the balloon from the wind, had been brought from Sweden, and the erection of this and other preliminaries consumed one month's time, and it was not until July 21st that the balloon shed and hydrogen gas-generating apparatus were ready. The balloon was inflated by the 27th July. All was now ready for the start, and it was only necessary to wait for a favourable breeze from the South. Andrée now experienced the discomforts of one who waits for the weather. A party of excursionists arrived to see the start, but departed after but a brief wait. Contrary winds prevailed with persistent continuance from the North, East, or West, but never from the South, which was the only direction of use. The captain of the Virgo informed Andrée that he must weigh anchor and depart shortly lest his ship be packed in the ice. Dr. Ekholm discovered that the leakage from the balloon amounted to nearly one per cent. per day, and expressed doubts as to its suitability for the purpose, although in my opinion it shows it to have been all that could be desired from a gas-holding point of view. After waiting 21 days in vain for a wind in a suitable direction it was decided to empty the balloon and postpone the ærial voyage until the following season. The balloon and portable accessories were reshipped, the shed and gas apparatus allowed to remain, and on the 20th August the Virgo started on the return voyage *en route* for Sweden. Thus ended the first season's expedition.

His Second Expedition and Start.

During the winter's interval the balloon was somewhat enlarged. Dr. Ekholm retired from the venture, and Messrs. Frankel and Svedenborg took his place, the latter gentleman, however, only to ascend in case either of the other three were for any reason unable to do so.

On the second voyage the steamer "Svensksund," lent by His Majesty the King of Sweden, carried the party to Spitzbergen, leaving Gothenburg on May 18th, 1897, arriving at Danes' Island on May 30th. The balloon shed was found somewhat damaged by the weather, but was repaired and ready by June 12th, and the inflation of the balloon (which took 4 days) was finished by midnight of June 22nd, more than a month in advance of the previous year. Another tedious wait now occurred, winds from all directions except the right one, until, on July 11th, 1897, the start was made. The direction of the wind even then was not quite right, it was west of south, whilst a due south wind was necessary to carry the balloon to the North Pole.

The party in the car consisted of Messrs. Andrée, Frankel, and Strindberg, and at the time of start the wind was sufficiently strong to be heard "whistling through the woodwork of the shed and flapping the canvas which hung over the upper part."

Andrée prepared a telegram for the newspaper *Aftonbladet*, in which he said, "At this moment, 2.30 p.m., we are ready to start. We shall probably be driven in a north-north-easterly direction."

The only authentic news received since the start was a message from the aerial voyagers brought by pigeon, as follows:—"July 13th, 12.30 p.m., 82 deg. 2 min. north latitude, 15 deg. 5 min. east longitude. Good journey eastwards, 10 deg. south; all goes well on board.—Andree." This was received by the fishing boat "Alken" on July 22nd, between the Spitzbergen North Cape and the Seven Isles, in about 80 deg. north latitude. I, however, cannot place reliance upon the accuracy of either the date or else the latitude and longitude given, as I am confident that the balloon would have travelled a greater distance in 2 days.

Some Facts.

The distance from Dane's Island to the Pole is about 750 miles, and to Alaska on the other side about another 1,500 miles. The course of the balloon, however, was not direct to the Pole, but towards Franz Josef Land (about 600 miles) and to the Siberian Coast (another 800 miles). Judging from the description of the wind at the start, and comparing it with my own ballooning experience, I estimate its speed at 40 miles per hour, and it will therefore be evident that a distance of 2,000 miles would be covered in 50 hours, that is, 2 days and 2 hours after the start. I regard all theories as to the balloon being capable of remaining in the air for a month as illusory; no free balloon has ever remained up for more than 36 hours, but with the favourable conditions at the northern regions (where the sun does not set, and where the temperature remains equable) a balloon might remain in the air for double the length of time, which I consider ample for the purpose of Polar exploration.

My Opinion and Theories.

For some time after the ascent of the balloon, I was in anticipation of news from Siberia. I suggested the New Siberia Islands as a likely destination, but it is not at all unlikely that the Taimyr Peninsular would be reached. Those learned in the drift of air currents have pointed out to me that the high currents bear to the right of the direction of those nearer the ground. Andree started away to the east of north, with the trail ropes keeping the balloon near the earth. Now, if my experiments with the trail-rope and sail have proved anything, it is the certainty that the balloon will after a time lift the trail-rope off the ground and soar aloft into the upper regions, floating onwards with the wind for some time before returning to earth to permit the trail-ropes again to act. The only alterna-

Digitized by Google

tive to this would be that the increasing friction of the ropes, if not lightened by the discharge of ballast, would bear the balloon downwards until some obstacle in the way caused a rip in the fabric and put a premature end to the journey. When Andree's balloon lifted its trail-ropes off the ground and rose, as I anticipate, it would reach more westerly currents, and, therefore, drift to the east, and if the journey was continued for 50 hours at 40 miles per hour, would reach those parts of Siberia between Cape Taimyr and the Tunguska River, whence several rumours of discoveries have emanated.

Not having news from Siberia during the season 1897, I wondered whether the explorers had descended near Franz Josef Land and made for the Jackson-Harmsworth Settlement, where provisions had been left for them in case of need. It was evident that they would have to winter where they were, and no news was likely to come to hand before the 1898 summer season. Wellman's American Expedition has been to Franz Josef Land, and has sent news in the autumn of 1898 that there were no signs of Andree there.

There appears to me only two possibilities—first, that the descent has taken place on the Polar Ice Field, owing to the wind having proved insufficiently permanent to carry them on further and the life of the balloon being exhausted, and the explorers, having been unable to reach habitable land, have perished, for I doubt if they could pass through two Arctic winters; or, secondly, what I consider the most probable event, they have continued on to the Siberian Coast with the balloon, and descended when it would carry them no longer. In either case I expect they would have descended on or about July 14th, 1897; that is to say, not more than three days after the ascent.

I do not expect there would have been much difficulty with the landing, as the balloon was provided with a "rending flap," by means of which it could be rapidly torn open by pulling a cord immediately it touched the ground, thus speedily emptying it, and avoiding dangerous dragging, even in tempestuous weather. Finding themselves now on *terra firma*, if no inhabitants were visible, it is reasonable to suppose that the explorers would build up a house or cabin from the material of the balloon, using the booms to which the sail was fixed as tent poles, the waterproof silk as sides and roof, and the car—if they had still retained it—as an inside sleeping compartment. If no natives were visible they would probably organise extended tours to discover them, retaining their impromptu tent as a base of operations and returning there as occasion required. Weather and wild animals may have rendered any very extensive journeys impracticable. They were provided with but three months' provisions, and guns and ammunition, and if, during the time they were able to eke out an existence with these means, they discovered no natives with further supplies, only one end awaited them, starvation.

RUMOURS FROM SIBERIA.

There have been two reports from Krasnoyarsk, the first dated September 17th, 1897, that is two months after the start, as follows:—"On September 14th, at 11 p.m., the people in the village of Antzifirowskoje, which is in the district of Yeniseisk, saw the Andree balloon for the space of 5 minutes."

Investigations into this report led to no discovery being made, but on the principal that "where there is smoke there may be fire," I submit either that some natives had seen the Andree balloon some time previously to the date given, or they may have seen a pilot balloon sent up by the lost explorers with a view to communicating by this means with the outside world.

The second telegram from Krasnoyarsk, giving the circumstantial account of the discovery of a cabin of cloth and cordage apparently belonging to a balloon, the three human beings, and a number of scientific instruments, by Tunguses, a tribe inhabiting the Taimyr Peninsular, in Northern Siberia, leads me to the natural inference that this is the remains of the Andree North Polar Expedition.

Officials are reported to have proceeded to investigate on the spot, and many experts have given their opinion, generally of a sceptical nature. I consider that Siberia, north of Krasnoyarsk, is a most likely place of descent, and I wait the result of the fullest investigation of the tales and rumours of the Tunguses.

I consider an expedition to Greenland, to the west of Spitzbergen, which has been suggested, useless for the purpose of discovering the Andree balloon party.

SOME SUGGESTIONS FOR FUTURE NORTH POLAR EXPLORATION BY BALLOON.

Andree's Expedition having shown that there are no inherent difficulties in the way of making a balloon ascent in the icebound regions of the North, it may be as well to at once consider in what manner this means of transport may best be utilised in future. First, I do not think the balloon party should go alone on their own merits, but should form a part of a larger expedition. It is the usual plan for Polar expeditions to take ship as far north as possible, there to establish a base, and then for parties to push on by sledges drawn by dogs. In this manner the furthest north has been reached—Markham to 83 deg. 20 min. latitude, in 1876, and Nansen to 86 deg. 13 min. 6 sec., 1893 to 1896. Records show that much time is spent in slowly pushing northwards, and the return journey has to commence before great progress has been made. When, however, the return journey has commenced, great distances have been travelled in the return to the south. Now, given a south wind of moderate force, a balloon is capable of carrying the sledging party, with sledges, dogs

ammunition, and food, over all obstacles, and to the pole in a few hours, say the 650 miles from Franz Joseph Land, in about 20 hours, if the wind is blowing at 30 miles per hour, or in about 30 hours if the wind is blowing at 20 miles per hour. These are reasonable journeys for a balloon and such as have been accomplished on several occasions. Thus in about one day we can place a sledging party fresh and in good form at the Pole. They may make their observation, plant their flag, or carry out whatever other object they may have in view, and proceed at once on the return journey, having every inducement now to hasten on and rejoin their companions at their base of operations. This is a scheme which could have well been undertaken in connection with the Jackson-Harmsworth Expedition, which for several years was stationed at Franz Josef Land. The plan would then have been to start in the summer and go by the ship "Windward," which went out every year with supplies. Remain there with Jackson all through the long winter night, during which time practice ice travelling, and become acclimatised, and upon the arrival of light, when the sun rises for the long day, prepare the balloon and make all arrangements for the ascent on the first favourable opportunity. This plan gives a much better chance of success than that adopted by Andree, who arrived at his base somewhat late in the season, owing to the fact that a ship cannot penetrate through the ice until the season has well commenced and the ice sufficiently thawed. A suitable due South wind may have been prevailing for some time but had been of no avail as they were not ready. Having arrived at their base all was hurry and naturally the captain of the ship is anxious to return as soon as possible, and the ascent had to be made or abandoned within too short a time to give a reasonable expectation of a wind in the right direction. With the sledging party all ready and balloon at the permanent base, as I suggest, a start may be made immediately the atmospheric conditions favour, as early in the season as possible. In connection with the technical part of the undertaking, I have to suggest the following plan. Take the gas compressed in tubes, as used by the British Army Ballooning Corps. By this means the balloon can be inflated in a short time when the wind is in the right direction, and there is no need to inflate it a long time in advance, holding it tethered in its inflated condition through all sorts of weather like Andrée did.

This enables a lighter make of balloon to be used, which can carry a greater proportion of cargoe, because the balloon need not be strong enough to stand the buffeting about it would receive during its long wait.

It dispenses with the need of the enormous balloon house or shed, a windscreen only being necessary, and this is easily erected. As for the balloon, lightness, strength, and simplicity are its desiderata, and the avoidance of all untried accessories. The number of trail-ropes used by Andree should be avoided as likely to become entangled, and one good long rope used which can be cut off from time to time and used as ballast and more lowered.

Andree's scheme was to float over the Pole, taking observations *en route*, and use the balloon as the vehicle by which to return, by continuing on until such time an inhabited country was reached. This necessitates a journey of more than 2,000 miles. My plan is to use the balloon to get to the Pole, and then abandon it and return by sledges. This means a balloon trip of 600 to 700 miles only—a much more likely distance to be practicable for the balloon.

The inaccessible regions of the North Pole may be reached by balloon if one has patience to wait for a suitable wind. Sledges, dogs, guns, ammunition, and food may be carried, and every means to enable the party to return. Whether that will be actually possible or impossible makes all the difference. Who will be the courageous person to take the risk, and obtain the honour if successful?

During the reading of the paper, a diagram of the Polar regions, as well as a number of photographs, kindly lent by Mr. Montefiore-Bryce, the Secretary of the Jackson-Harmsworth Expedition, were thrown on the screen.

The CHAIRMAN, in opening the discussion, mentioned that he did not himself see the practicability of carrying dogs and sledges in the balloon, unless it was a very large one. He quite agreed with the lecturer that it seemed impossible for a balloon to remain in the air for a great length of time, owing to variation in temperature. There is no doubt that a trail rope in trailing through water causes very great friction which has a tendency to pull the balloon down. Over ice the friction might be less. The alleged discovery of the bodies and balloon in Siberia did not seem in his opinion, likely, since, if the descent had been a rough one, one or other of the aeronauts would have been thrown out, and the bodies thus scattered over some distance.

CAPTAIN BADEN-POWELL pointed out that in the newspaper reports of the time, it was stated that the action of the trail ropes, was such as to cause Andree's balloon to take a direction if anything west of north, even though the wind was from the S. S.W. Perhaps this was not accurate, but anyhow the wind would be likely to change its direction after a time, and the locality of the descent must be very doubtful.

Digitized by Google

Mr. SPENCER said there was no difficulty in making a balloon large enough to carry the weight of all the men, sledges, dogs, food and amunition which the steamer brought. With reference to the direction the balloon is supposed to have gone, it is possible that the report referred to was that of those who *hoped* the balloon would go due north. The Captain of the "Windward" at Franz Joseph Land, kept a record of the direction of the wind on the days following the ascent, and found it day by day, to have varied between S.W. and N. W. It seems therefore, most probable that the balloon would have veered round to the right, towards Siberia.

Mr. ELWORTHY suggested that a number of balloons might be sent up from different places, and their exact direction noted. They could be numbered so that if found they could be recognised. Of course the differences of currents at varying elevations would have to be taken into account.

Mr. J. D. WHITE asked first whether it would not be better to do without a trail rope, which, though it regulated the height, also decreasd the speed of travel. Secondly, with regard to the cap covering the top of the balloon, was this to minimise the danger of a fall of snow? which would add a very great weight to the balloon. There would be a surface of perhaps 5,000 square feet, which could support a very considerable weight of snow. Could Mr. Spencer suggest any way out of this difficulty?

Mr. SPENCER replied with reference to the despatch of a number of pilot balloons, that he thought very few of them would ever be found again. They would generally be carried away by the lower currents, and observations on the clouds would probably be more suitable. With regard to trail-ropes, he thought there was a distinct drawback to them, since they slowed the speed. But it is very difficult to keep the trail-rope on the ground at all. Either the balloon lifts it off, or descends to the ground. A thousand feet of rope hanging from the balloon is a useful addition, as it prevents the balloon from coming down with a crash. The question of snow on the top is a very important one. The cap, of smooth material, was chiefly to keep the snow from lodging in the ledges formed by the net-work. It would be better in case of a snow fall, to rise above the clouds.

Mr. PILCHER asked what angle with the wind, the lecturer thought that Mr. Andree could get by using his sail.

Mr. SPENCER could only reply from personal experience. He had never been able to get a greater divergence than 3 degrees, and then it was impossible to keep the rope on the ground for more than say 5 per cent of the journey.

Mr. PILCHER asked if the weight of the gear would not have been better expended in ballast.

Mr. SPENCER said you could always get rid of rope or other gear, so you might just as well take it.

The CHAIRMAN then proposed a vote of thanks to the lecturer, which was carried by acclamation.

The Balloon as an Instrument of Scientific Research.

By REV. JOHN M. BACON, F.R.A.S.

A paper read at the Society of Arts on Wednesday, Feb. 15, 1899; Captain BADEN POWELL, Hon. Secretary to the Aeronautical Society of Great Britain, in the chair.

In the first years of the century, the Russian Academy organised, at St. Petersburg, what may be regarded as the earliest balloon ascent for genuine scientific research. One chief object which they had in view was to determine any difference in conditions existing at various altitudes above plain country as compared with those observed by Humboldt, Saussure, and others at like elevations on mountain heights, and that this is even still an important line of inquiry for which balloons are eminently well suited, I shall hope to make sufficiently clear. The experiments proposed, which, to-day, read quaintly suggestive, were to include an investigation of the power of solar rays, of the existence of electric matter, and of the intensity of the colours of the prism. No results of consequence, however, were obtained.

About the same period, Gay Lussac made experiments on the same lines at Paris, obtaining for the most part only negative results. Then a considerable interval elapsed before scientific ballooning was again seriously resumed, when the British Association instituted a series of experiments mainly by the use of captive balloons, but without any noteworthy success. A few years later, MM. Bixio and Barral made some interesting observations during lofty ascents chiefly on temperature variations, leading up to more important work in the same direction carried on in 1852 under the auspices of the British Association, when Mr. J. Welsh obtained results of considerable

value, which were published in the "Philosophical Transactions" in the following year. Some of the more remarkable of these I shall presently summarise, and endeavour to show that they suggest one important point which has perhaps scarcely received due attention.

It was practically at this stage that Mr. Glaisher took in hand those classical and exhaustive labours, which have found place in the front rank of scientific investigation of that date. The primary objects of his researches briefly put, were—To determine the temperature of the air and its hydrometric states at different elevations, and to investigate the distribution of water vapour below the clouds, in them, and above them. I proceed to present in outline certain of his more remarkable results for the purpose of bringing them into correlation with those of other aerial explorers.

Basing his deductions on 28 ascents, Mr. Glaisher was the first to prove clearly that the decrease of temperature with elevation is far from constant, as former theorists had asserted, and, moreover, that during midnight hours there is generally an increase of several degrees. In collecting results together he is careful to distinguish between clear and cloudy days, but it will suffice for my present purpose to show graphically the general law of decrease of temperature with height which he gives for clear day skies. In his own words, "the change from the ground to 1,000 feet was 6·2°, at 10,000 feet it was 2.0°, at 20,000 feet high the decline of temperature was 1.2°, at 30,000 feet high the whole decline of temperature was found to be 62.°," Having thus a formula, it becomes instructive to read it in the light afforded by individual and exceptional cases; but I would first compare it with the results, already alluded to, obtained by Mr. Welsh.

This observer, in my opinion, deserves more attention than seems to have been accorded to him. Hailing from Kew Observatory, he had the advantage not only of special training, but of the best instrumental equipment that could be furnished, and his observations give proof of having been successfully carried out with the most careful attention to all details. He made four afternoon ascents during summer and autumn, under clear as well as cloudy skies, and in all four his temperature readings show one very noteworthy characteristic which I shall first describe in his own words. "The temperature of the air," he says, "decreases uniformly with height above the earth's surface until at a certain elevation, varying on different days, the decrease is arrested, and, for a space of from 2,000 to 3,000 feet, the temperature remains nearly constant or even increases, the regular diminution being afterwards resumed, and generally maintained at a rate slightly less rapid than in the lower part of the atmosphere, and commencing from a higher temperature than would have existed but for the interruption noticed."

Let us look at this on a diagram drawn alongside Mr. Glaisher's general curve (Fig. 1). I

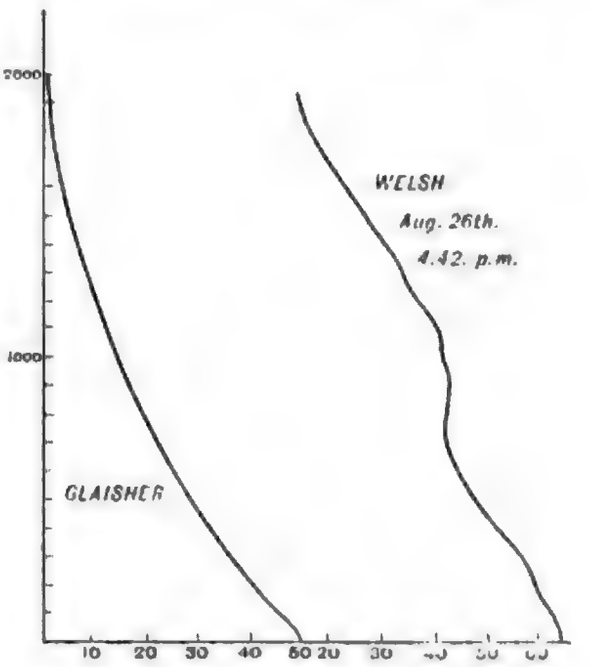


FIG. 1.

have taken a clear day in August, but the curve drawn would almost serve to illustrate each and all of Mr. Welsh's experiences. The remarkable halt he speaks of occurs in the clear air, commencing at 7,200 feet. Nine days previously, when the sun was constantly obscured, the bend in the curve commenced at 4,000 feet. On October 21, when he ascended in cloud and showers, the same bend occurs, but at 2,500 feet. Once more, on November 10, when he surmounted all cloud at 4,900 feet, the curve remains fairly regular until a height of 5,100 feet was reached, when, now well in the clear, the same remarkable check and recovery is recorded. This, I think, calls for further consideration, but returning for the present to Mr. Glaisher's account, we find him calling attention to a most instructive case which again can be illustrated by a simple figure.

It is now early spring, with wind from the S.E., the ascent commencing some two hours before sundown. The diagram explains itself, but the most important comment was supplied by Mr. Glaisher himself, who says:—"Our course was most remarkable. After passing over the Thames into Essex, we must have

Digitized by Google

re-crossed the river, and moved in an entirely opposite direction until we approached the earth again, when our direction was the same as at first." (Fig. 2.) And now, at this particu-

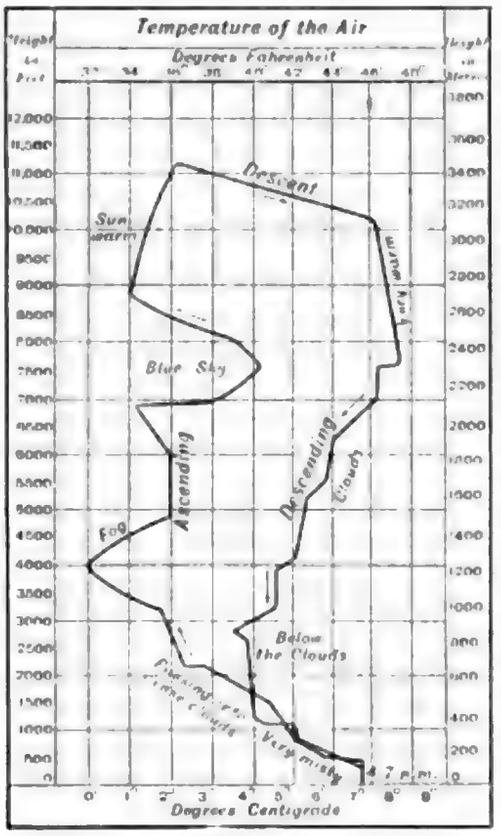


FIG. 2.

lar stage, let us compare these early results obtained by the balloon with typical diagrams prepared from recent records systematically taken by high-flying kites.

Here, under a clear sky, the decrease of temperature is practically regular up to a mile or more, but on an occasion where cloud was met the decline has been abruptly arrested. (Fig.3.)

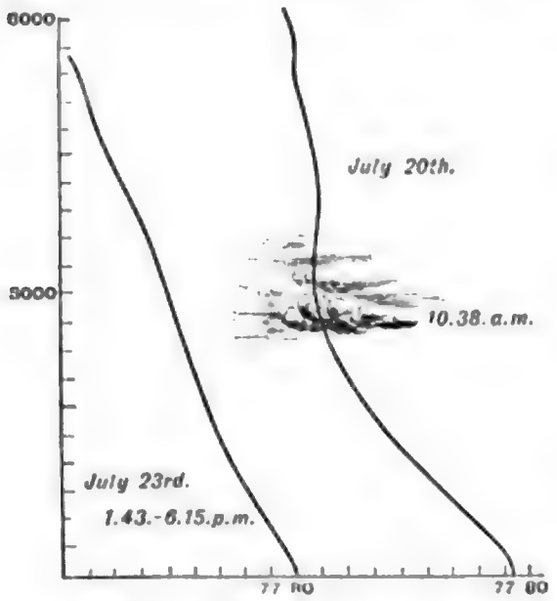


FIG. 3.

These curves accord well with those just considered, and point to an agreement in the two systems of observing, each method, however, performing its special function. The types of instruments used with kites should be noticed, and they may be considered scarcely of such a character as could respond very readily to rapid changes of temperature. Indeed, it has been customary to assume that five minutes are required to overcome the sluggishness of the instruments used, while, on the other hand, an observer in a free balloon can apply constant and needed corrections, as, for instance, by the use of a simple "sling" thermometer. Also, when the balloon is balanced, by a mercurial barometer; and he can read from moment to moment the fluctuations in a delicate air or other thermometer as he penetrates some shallow layer. Further, the kite-flyer clearly cannot, equally with the aeronaut, make sure of what is to be seen above the lowest cloud floor.

However, we can already duly interpret in the light of thirty years ago, as well as of to-day, a typical picture of our skies. Take a day in rainy July, as given by Mr. Glaisher, which, briefly described, reads thus:—Leaving a temperature of 618 on the ground, mist and then rain are quickly reached, and the first clouds left behind at 1,200 feet, where the temperature was 59°; further cloud is surmounted at 2,800 feet, the thermometer reading 548, then 558, and again 538; then with a smart descent dry fog is reached, growing wetter lower down, at a temperature of 57°; ascending again to 3,300 feet, the thermometer registered 53°, and finally getting down through squalls of wind and rain, the temperature of earth was found unchanged. Clearly it has not been established that visible cloud, and that alone, affects temperature in upper regions according to any fixed law. Humidity moreover has proved a very variable quantity, the most obvious law involved perhaps being that so commonly made patent to the eye, by familiar cumulus clouds forming in daytime at a height, say of from 3,000 to 6,000 feet, and disappearing again at night.

An all-important matter, however, which had up to this point been generally agreed upon by aerial observers, is that various currents are very commonly to be found flowing within definite but shifting beds, at all and varying heights until the dominant drift is reached. The prevalent trend of these greater streams was indeed seriously considered as long ago as the days of Green in England and Wise in America, both of these experienced

Digitized by Google

aeronauts having been prepared to essay a voyage across the Atlantic by a main upper current thought to prevail in the direction of the earth's rotation.

We can now with proper appreciation pass on to consider the work embraced in the scheme rapidly developing under the auspices of the international organisation now in active progress in other countries. Supplementing the work done by simultaneous ascents of captive and free balloons, we find that far beyond the limits of human endurance the unmanned or sounding balloons, despatched from large centres lying in the heart of extended country, having ascended and brought down self-registered readings showing altitudes and temperatures never dreamed of. The experiments with this class of balloon, which have been conducted at Berlin under the direction of Assmann, Berson, and others, have been as successful as they have been ambititious, and with a free balloon of 8,800 cubic feet, and possessing a net-lifting force of nearly 300 lbs., an altitude has been reached of upwards of 60,000 feet, as indicated by a barometric pressure of about 2 inches of mercury, while a temperature of –88° Fahr. was recorded. A temperature lower yet by 6° has also been recorded by a very similar balloon despatched from Paris.

Let us look first at some of the equipment of these balloons. The German instruments have been rendered extremely perfect by the use of photographic registration, and by mechanical ventilation of the aspiration apparatus. It will be supposed that a certain unavoidable lag attaches to any such instrument, temperature measurements reading too high in ascents and too low in descents, and it must also be observed that while the mean temperature of the whole mass of air is unknown, the altitudes, which are calculated on the well-known formula of Laplace, cannot be regarded as exact. Moreover, in spite of every possible precaution, it is open to question whether at extreme heights the registration can be relied on, and whether on that account the readings be not somewhat in error.

Balloons of the above description designed for high flights, being without controlling hand, are subject to certain disadvantages, among which must be mentioned the rapidity of vertical motion and the liability of the top of the balloon to become hollowed inwards by the pressure of the air as shown in the lantern slide. To obviate this an ingenious plan was devised by Capt. Kowanki, for automatically emptying ballast and dropping the bag. Other considerations affect this class of miniature aerial craft. M. de Fonvielle has recently pointed out that the ascending power of the free balloon is found to depend greatly on the character of the envelope by which the enclosed gas may be caused to maintain a considerably higher temperature than the surrounding air, and thus it is found that the altitude attained may vary as much as 6,000 feet between winter and summer, and 8,000 feet between day and night.

The result of these modern researches may be to modify somewhat that sectional drawing of the atmosphere which we have hitherto regarded. I submit a diagram for which I am indebted to M. de Fonvielle of the temperature readings given by a balloon sounding the depths of the aerial ocean up to some 42,000 feet. (Fig. 4) It goes without saying that

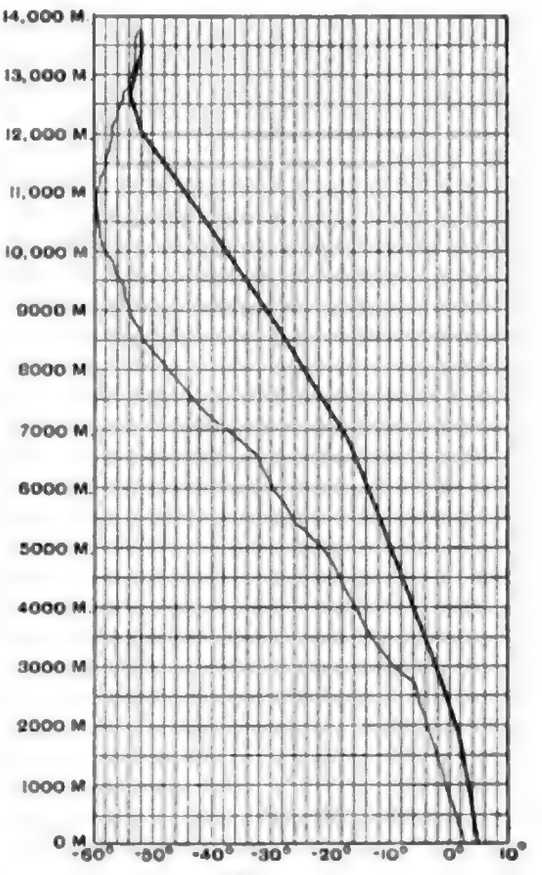


FIG. 4.

within the circumscribed area of our own country, it is hardly possible to compete on equal terms in the celestial competition now being organised on the Continent, but outside meteorology there is still a field as wide as the heavens open to the balloonist for scientific inquiry.

Many years ago, we find Professor Tyndall expressing a desire to make use of a captive balloon to determine whether sound waves travelling to windward may not be tilted over

Digitized by Google

the heads of observers; and it is with genuine disappointment that we read on and find that on communicating with Mr. Coxwell he learnt that the experiment was deemed too dangerous to be carried out.

Having the solution of this question as one chief end in view, I made arrangements for a series of right-away balloon ascents to take place during the past summer and autumn, and seven in all were carried out, under conditions differing as widely as a long-continued dry season would admit of, and including one night ascent at the end of September. Some observations were secured that at least, indirectly, throw light on the above question, but first other facts came more readily to hand. Professor Tyndall, in a series of laboratory experiments of great refinement, showed how in a tunnel or cupboard, which remained optically clear, the passage of sound was powerfully influenced by differences of temperature, whilst the densest fumes within these chambers offered no appreciable obstacle to sound waves so long as a uniform temperature was secured. I proceed to submit and illustrate as the outcome of my own aerial research, if not a fresh aspect of this matter, at least further considerations of the travel of sound in our own atmosphere. Broadly speaking, there have been days during the past summer, equally clear and brilliant (as judged of by the eye, or by photographs taken on the ground), when sounds travelling upwards have differed vastly in penetration. This has been tested in various ways. The heights have been carefully recorded when certain sounds have ceased to be audible, and these have very generally expired in their own due order. We find M. Flammarion stating that the whistle of a locomotive rises to near 10,000 feet, the noise of a railway train to 8,200 feet, the bark of a dog to 5,900 feet, the crow of a cock and the sound of a bell to 5,000 feet, and so on, but these records must be taken as mere averages, they may, on occasions, have to be added to or diminished by as much as one-half, even on such days as (so far as can be determined from earth, optically or by meteorological readings) have been practically indentical. Similarly, the test of echoes from earth, verified by constant repetition, have told the same tale. Another test tried with the same result has been an adjustable resonator applied to the ear and tuned to catch most readily the continuous murmur from earth, sometimes to be detected in this way, over a vastly extended vertical range.

The two series of pictures I proceed to show represent two days when acoustic conditions were normal, the photographs at all heights are equally and very unusually brilliant, but the noteworthy fact is that on one occasion the air up to 3,000 feet was unusually dry, and on the other was nearly as the point of saturation. The next two series of pictures were again taken in brilliant sunshine, as shown, and each were characterised equally by a blinding glare as seen from above, while acoustic conditions were then entirely at variance. As one proof of this, it may be stated that ground echoes throughout one voyage could not be heard anywhere at 1,000 feet, while on the other they were heard up to 2,500 feet. I would draw special attention to the glare to which I have alluded. It is presumably due to reflection off matter in suspension. Certain particles in the lower air present their sunlit surfaces to the observer or camera aloft, causing a dazzling reflection of light which admits of no mitigation, but which to the observer below has no existence. That these particles are other than those of water vapour would seem probable from the photographs I have shown. Are they dust?

I have made a great number of experiments to determine the presence of dust in the air during my balloon ascents by the use of an Aitken's dust-counter, and also by passing a known volume of air into samples of liquid, which have been subsequently compared. I have been driven to the conclusion that dust exists at different heights, and, as it would seem, not only in mere strata, but in discrete masses possibly comparable with visible clouds. I should have a similar remark to make with regard to the presence of carbonic acid. There appear to be more traces in certain tracts, and, as tending to bear out this view, I would add that I have made several series of uniform exposures with sensitive films with the object of testing the actinic qualities of light from the sky at different heights, and, so far as my experiments have gone, it would appear as if altitude were not the only factor in the case. In the clearest sky, and in the same quarter of it, it would seem as if clouds of some nature intervene perfectly transparent to the observer below, but offering resistance to certain waves of light and sound. Tracts of air relatively warmer are very commonly present above. During a night ascent, having armed myself with a delicate air-thermometer, to which I gave the closest attention, I found over different localities, and at many different heights, sheets or pools of air, often shallow, 12° or 15° warmer than the temperature of earth: and, from Mr. Welsh's records already

referred to, it is conceivable that something akin to an aerial gulf stream may for a whole season flow but a few thousand feet aloft.

Were an eye so constituted as to be able to see, say, cumulus masses of warmer air, strata mottled with traces of other gases, and beds of invisible matter in suspension, one might suppose that what we deem the clearest sky would then appear flecked with forms as many and various as the clouds that adorn our summer heavens.

With regard to motion in the atmosphere, it may be stated that if the loftier and broader streams of air are found confined within definite courses, it is common in lower levels to find the wind blowing in gusts that, as it were, break up aimlessly into wandering rills. This has been particularly noticeable in kite-flying experiments, before upper currents have been reached. I submit that we have an analogy here in the way in which a drop of ink, when falling through water breaks up into numerous curling streamlets. If we can picture gusts traversing by some such mode the lower strata of air, it becomes conceivable that these may be the vehicles that convey for a fleeting interval those fugitive sounds that appear for a moment to leap across great distances. These are well-known phenomena in balloon voyages, which I have studied with the conviction that, when borne upward, they are carried by ascending shafts of air leaning or wandering with the wind. A chance sound that has reached the silence above by a "long shot," has been noticed to come not so often overhead as to windward of its source. Other evidences, too, are not wanting of the erratic or sportive course of lesser currents. At upwards of 3,000 feet we have seen thistle down pass us from below, straying aloft on some unseen "up-draught." Again, we watch the cloudlet fray out in writhing wisps and twisting streamers betraying the wanton fluctuations of the stream that bears it. Professor Tyndall's observations in Hyde-park on the fitful hearing of the Westminster clock, though not made under very advantageous conditions, would support the view that the fickleness of distant sound may be in great measure due to the play of various currents. The ear was confessedly assailed by a tumult of other noise, but clearly also the air traversed was influenced by a multitude of intervening thoroughfares, blocks of buildings, and stacks of chimneys, which must have been the certain cause of conflicting currents.

Following up the experience gained in ballooning travel, I have lately made investigations of these fugitive sounds during continuous observations carried out through day and night hours on the Maplin lighthouse, standing far out at sea, and built on framework, against which there is no appreciable lap of water. Here sometimes the higher, and again sometimes the lower, galleries catch sounds more readily, and on one noteworthy occasion the first sounds heralding the approach of a distant steamer rose momentarily over an interval estimated at five miles. In this instance there could be no argument in favour of sound waves being tilted either upwards or downwards, and I conceive that the important question of the inaudibility of sounds at certain points within due range may need very searching investigation, in which the balloon must surely be an all-important instrument of research.

I would mention, in this connection, that in one recent voyage where the balloon lazily floated at low elevation, following the line of the Bath-road westward from Newbury, the voices of countrymen, and more particularly of children, were heard easily in our wake, over distances well exceeding a mile, the wind being very light, but a party of Tyrolese singers were unheard, though performing at no greater distance in a direction across the wind.

A very special advantage of researches made by an observer in a free balloon will always lie in the complete isolation of his observatory. He has command of a region of perfect silence and tranquility, and he has the power of altering his scope and station rapidly and without disturbance. Even the direction and rate of travel of the balloon is often under control to a very considerable extent, not so much by any method of guiding, which is very limited, and attended with obvious disadvantages, but by due observance and use of the variety of those currents already spoken of, which are often within reach. As far back as the historic voyage of the "Nassau" balloon, in 1836, Green's keen observation and admirable judgment enabled him by a masterly stroke of navigation to avoid being carried, at nightfall, out over the North Sea, and to hold his desired course across the straits of the Channel.

The track of one instructive balloon journey occurring in my own experience, and extending over the mere width of Sussex, will serve to further illustrate this point. In the Palace grounds the wind was so light that, at my suggestion, the heavy grapnel was left behind, so as to give us more lifting power, and with a lazy drift to the eastward we ascended by easy gradient to a height of 2,400 feet, by

Digitized by Google

which time we were over Penge, and maintaining the same direction. So also until we had reached 3,300 feet, and dropped again to 2,400 feet, at which point we were over Bromley and there entered a considerable current from the north-west. Steering then a fairly direct course with sundry fluctuations of height and direction, an altitude of 8,500 feet was reached near Hawkhurst, when, our course being rapid and nearly due south, we were quickly carried over Hastings old town. At this moment, though the management of the balloon was wholly entrusted to the unrivalled skill of Mr. Percival Spencer, I confess I was unable to see any way to avoid our dropping in the sea, save by trying conclusions among the forest of chimney-pots that already lay below us. But the discrimination of our aeronaut was prompt and unerring, and with a display of perfect judgment a descent was made to where the lower westerly current was once again encountered, now blowing stiffly along-shore, and we were thus brought-to near the verge of the cliffs, in the outskirts of Fairlight Glen.

But there are possibilities in the balloon for much other physical investigation, and this by virtue of the fact already insisted on, that in an aerostatic observatory, we may remove ourselves from all disturbing influence of earth. Mountain observatories may show an elevation of 4,000 feet and upwards, and even claim a certain freedom from radiation off the valleys, by reason of lower circumjacent fogs, but the very nature of a mountain is such that grosser air is attracted and hangs about its height, and, as a consequence of the neighbourhood of rock surfaces more or less heated, currents of local origin, even under most favourable conditions, must be constantly finding upward or downward passage on slopes of unequal and varying temperatures.

The force of the wind is another difficulty to be reckoned with. It was said at one time on Mount Hamilton that the wind often blew at the rate of 60 miles an hour, and that a greater velocity was never recorded only because at that point the anemometers carried away.

With the additional instrumental aid of properly designed spectroscopic and telescopic camaras, it is reasonable to hope that at high elevations we may penetrate with greater success than heretofore into the ultra-violet of the spectrum, and even under conditions of diminished air-glare to photograph the sun's corona without eclipse. It is easy to conceive how valuable experiments can be made when all that is "British" of the atmosphere is left below, dealing with questions of refraction and other problems; and, I think, we may go further and even venture to hope to put to a crucial test some of the markings on sister planets and other celestial wonders that have been elsewhere claimed as visible with very humble instruments, or else, by yet happier chance, to banish them for good beyond the limits of all controversy.

DISCUSSION.

The CHAIRMAN said they had had the most interesting details of Mr. Bacon's numerous ascents, especially as many of his experiments were of a nature quite unlike any previously made. The acoustical experiments were of special interest, and would no doubt prove to be of considerable importance. He could quite appreciate what had been said about the variability of gusts of wind, from his own experience with kites, though he was inclined to think there had been some exaggeration with regard to steady currents in different directions in the upper air. It seemed to him that if there were any great variety of currents, they would be shown by the clouds, and although occasionally they did see clouds moving in different directions, yet on ordinary occasions they all seemed to be going more or less the same way. He had watched the stream of highest cirrus in the region of the trade winds, and it was wonderful how steady the current seemed to flow in the opposite direction to the trades, though the motion appeared very slow, and would probably escape the notice of the ordinary observer, unless it were watched against some celestial body, such as the moon. He knew the difficulty there was in ballooning from not being able to depend on the current of air. On one occasion he made an ascent from Aldershot, with the intention of going to Ascot; the day was cloudy, but they got above the clouds, and, after a time, thinking they must be about over Ascot, descended, and found themselves on the other side of Guildford, having gone in almost exactly the opposite direction to what they intended. This led to the question of balloon steering, and he could not help referring to the latest reports with regard to the bold adventurers who started some two years ago to explore the Arctic regions. These reports seemed to have more semblance of truth than some previous rumours, and though it would be very sad if the death of those brave explorers were confirmed, it would be some satisfaction to have a record

Digitized by Google

of their journey. Several attempts had recently been made to test the principles adopted by Andree—of steering by a sail and a guide-rope—but, unfortunately, they had been rather meagre, and he hoped to take part soon in some more thorough tests of longer duration. But, after all, this method was somewhat rough and primitive; and what the public wanted to know was when there would be a really navigable balloon. There was, in his opinion, only one simple reason why that had not been attained, and that was that they could not get the needful money. Hitherto, all attempts had been on a very small scale, and the balloon of to-day might be compared to the coracle of the ancients. It was a small vessel, capable of lifting two or three men, and simply drifted with the current. Occasionally attempts had been made to propel a balloon against the wind, and on several occasions one had been propelled at the rate of some 14 miles an hour, but they were only small experiments in what we may call aerial canoes. They had recently read about the greatest attainment in modern shipbuilding, the *Oceanic*. He had made calculations, from which it appeared that if, instead of being an ocean liner, she had been an aerial vessel with a length of 700 ft. and a diameter of 70 ft., she would contain 2,500,000 cubit feet of hydrogen, and would lift a weight of 180,000 lbs. With due allowance for the weight of such a structure with engines of some 2,000 horse power, there would still be available lifting power to carry 200 passengers, or soldiers with their arms, and he could not see any insuperable difficulty in constructing a balloon of that size, with engines which would give a speed of 30 miles an hour. Even if such a vessel were dependent upon fine weather, would it not be most useful? He looked on these things from a military point of view, and he thought such an instrument would be of incalculable value not only in a European war, but for such purposes as fighting amongst the pathless mountains on the Indian frontier, or the swamps of Africa. They had heard a good deal lately about universal peace, but he thought this would be a solution of the difficulty, for if one nation possessed such powerful machines, she could dominate all others. England, by possessing a strong navy, was able to dictate to other nations, and she would be in a still stronger position if she possessed powerful machines capable of traversing the air. Perhaps this was rather diverging from the subject of the paper, but with regard to scientific research also, most extraordinary results would be attained by means of navigable balloons. If they had frequent reports of the state of the atmosphere at all heights, round the country and out at sea, practical meteorology would be very much assisted. All difficulties, too, of geographical research would disappear.

Admiral Sir Erasmus Ommanney, K.C.B., asked whether the magnetic compass retained its directive force at high elevations.

Mr. Percival Spencer said he had listened to the paper with the greatest pleasure, for though he had had the honour of accompanying Mr. Bacon on most of his ascents this was the first time he had seen the photographs. The meetings of the Aeronautical Society generally dealt with abstruse subjects more visionary than real, but here they had seen the actual results. The last time he was in that room it was to listen to an account of a flying machine by Mr. Davidson; it seemed to be a cross between a navvy's pick-axe and a blacksmith's anvil, and though the author demonstrated theoretically how well it would work, he was not aware that he had ever got an inch off the ground with it. In former days the Balloon Society dealt occasionally with this subject, but it had now ceased to exist, and given place to the Aeronautical Society, and he should like to see its discussions take a more practical turn. Mr. Bacon had shown how a balloon could be used as a floating observatory, and it was evident that a great deal could be done with balloons even as they existed at present. It was all very nice to talk about steering balloons, but there was one unfortunate point to be borne in mind. When in an ordinary balloon, going with the wind, you were in an absolute calm; but if an immense aerial machine such as the Chairman had described, were constructed, propelled with enormous force, all that would be changed, and the pleasures of ballooning would give way to the ordinary discomfit of a sea voyage. He well remembered how tranquilly he floated across to Havre recently in a balloon, and how in coming back by steamer, he was interrupted many times in writing his article for the *Times*, by occurrences which were anything but pleasant.

Mr. Eric S. Bruce thought one of the first things to be aimed at in balloon manipulation was an improvement in the power of vertical motion, so as to be able to rise without a sacrifice of ballast, and to descend without a sacrifice of gas. It had been said that ballast was the life-blood of a balloon, and it was quickly exhausted. It was, of course, a difficult problem, but he could not help thinking that Professor Dewar's achievements in

Digitized by Google

liquefying hydrogen might be turned to advantage. At any rate, this was the most important thing; the direction of horizontal motion was quite secondary. Mr. Bacon was to be congratulated on his efforts to explore the higher regions of the atmosphere, for meteorological science was being kept back from the want of men of sufficient heroism to trust themselves to a bag of gas: and it was a great pity that more systematic experiments could not be carried on in this direction. Mountain stations were always affected by terrestrial disturbances, and the value of isolated observations had been shown even in the case of the Eiffel Tower. He believed that the varying currents depended very much on the electrical condition of the atmosphere, for they were very frequent during thunderstorms. He had made a number of experiments in Switzerland with pilot balloons when thunderstorms were in progress, and found that numerous currents were flowing in different directions, though he had no instruments on the balloons by which the currents could be measured. The thanks of all interested in aeronautics were due to the Chairman for having practically resuscitated the Aeronautical Society. He had increased not only the number but the quality of the members; having persuaded some eminent men of science to join, and to take an interest in the subject, which must tend to stimulate invention and discovery.

Mr. G. Fentum Phillips thought Government ought to find the money necessary for constructing aerial machines. The nation which first possessed a navigable balloon would certainly be in a position to dictate to other powers; and such an achievement would be far more practical than any amount of talk about universal peace. When they saw governments like that of the United States or Great Britain spending a million and a-half on a battle-ship, which would be utterly useless in the presence of an aerial vessel, he thought the Government might reasonably be asked to vote a certain sum of money to a council formed of scientific men and engineers, to deal practically with this question. You could not expect a private individual, even if he were a millionaire, to devote half his life and the whole of his fortune to a project from which he would derive no benefit.

Mr. Leon Gaster said an ordinary sized balloon was quite sufficient for scientific research, and he did not think an immense structure, such as the Chairman had alluded to, rendered buoyant by gas, would be a practical machine. For the purposes he had in view, a flying machine would have a much better prospect of success.

The Rev. J. M. Bacon, in reply, said with regard to the magnet, Mr. Glaisher had reached as great an altitude as anyone, and it was one of his favourite experiments to test the oscillations of the magnet under all circumstances. He had never recorded any failure of the directive power. His own instrumental equipment was so inadequate that he could not give any personal opinion on the question raised.

The Chairman then proposed a cordial vote of thanks to Mr. Bacon, which was carried unanimously, and the meeting adjourned.

A Method of Steering Balloons during Ascent and Descent.

By D. Biddle, M.R.C.S.

The principle of this invention consists in giving lateral motion to balloons by utilizing the resistance of the air, during successive ascents and descents, by means of a large triangular sail, placed between the bag and the car at an oblique angle with the horizon; and in rotating them at will by means of a smaller rudder-sail, which is capable of turning on a horizontal axis. The sails are constructed to furl readily.

The principle was first applied to a buoy, depressed to the bottom of a running stream. As it rose it could be made to turn in either direction, according to the setting of the rudder, and would proceed in a course *opposed to the stream* if thus directed, and all by passive means. When weighted it would act similarly during descent. On removal of the weight, it would continue its course whilst re-ascending, and so on. Anyone can experiment for himself, at a trifling cost, in this way.

Provisional Protection was obtained, under date 17th August, 1875 (No. 2,901), and the Provisional Specification contained the following description of the special apparatus:—

1. There is a peculiar arrangement of the ropes supporting the car. The net covering the bag is as usual, but below the belt, bracing the ropes together, the ropes are made to cross, so as to leave three æqui-distant open spaces.

2. In the axis of the balloon is a light mast, reaching from a little above the car to a little

Digitized by Google

below the aforesaid belt. Ropes radiate from one of its extremities to the belt, and from the other to the car, so as to keep it in position.

3. Affixed to the lower part of this mast are sockets for the reception of rods or yard-arms. All the sockets work on hinges vertically.

4. There are three chief yard-arms corresponding to the three open spaces between the ropes. Two of them radiate from the mast horizontally; the third when in position is at an angle with the horizon. The distant ends of these three rods are connected by light cords.

5. Within the space formed by these cords lies the sail, attached both to the cords and to the rods, so that its figure is that of three triangles in one (presenting a concave surface to the resisting air). An opening is left over the car to allow the ropes to pass, and for inspection of the balloon.

6. Pulleys are attached to the upper part of the upright mast, over which cords play for drawing up the yard-arms when furling the sail. The yard-arms are also attached to the car by other cords.

7. The large sail can be reversed by shortening one of the yard-arms (that extending to the apex of the sail), a deeper socket being provided for this yard-arm. The other yard-arms maintain the same position (horizontal) during both ascent and descent.

8. There is a fourth yard-arm capable of being rotated on its axis. This rod passes through a ring at the bi-section of the cord joining the two horizontal arms of the larger sail, and beyond this point bears a fish-tail rudder, which being inclined by rotation more or less obliquely, rotates the balloon in either direction when it is ascending or descending. (When vertical, which is its normal or neutral position, the rudder further serves the purpose of steadying the balloon in its course.)

It should be mentioned that the principle, though independently discovered by the present writer, had occurred, ten years earlier, to Monsieur Menier, of France, who, however, applied it differently, namely, by wings and rudder attached to the widest part of the bag. I was in happy ignorance of this for twelve months.

Now comes the question. How are the continuous ascents and descents, requisite for rendering the invention effective, to be carried out?

Monsieur Menier adopted the old principle of hot-air balloons, and for the purpose employed an enormous Argand burner, with a metallic chimney some 2 ft. in diameter, and by turning the burner up or down he hoped to ascend or descend with ease. But to the best of my recollection, at every experiment on a large scale, the balloon was wrecked by flames.

The principle which commended itself to me, and which answered perfectly in the case of buoys under water, was that of compression and relaxation of the contents of the balloon, or rather balloons, for I employed three of equal size, enveloped in separate nets, braced together by a triangular web at the summit, and having a powerful rope passing from the centre of this to a winch within easy reach of the car. In place of the usual ring or belt, there was a stout framework of rods, forming a horizontal triangle, to which everything was attached, each of the three nets having its special vertex, and the yard-arms of the large sail being at the mid-points of the sides. Under ordinary pressure the balloon would ascend to a sufficient height, and then a few turns of the winch would cause it to descend far enough for working purposes, when liberation would again cause the balloon to ascend, and so on. A small additional pressure per sq. foot would suffice to cause descent through some hundreds of feet.

How Birds Fly.

By T. N. Hugo.

How birds fly, and what is the force employed to sustain and propel them, has been so often discussed that most would think the subject exhaustively explained and thoroughly understood. Yet it is doubtful whether such is the case, seeing that many now are inclined to ascribe the phenonemena of forward flight to the curvature of the surface of the wing. Another view, and a nearly opposite one, is this, that the wing's chief function is that of sustaining, and has but slight propelling property, and what propelling power the curvature of the under surface endows the wing with, is exerted in giving a forward course to the wing itself in its descent; this is the view that will be sought to be worked out in this paper. In allowing that the "curvature" (which, in this paper, is to have the special meaning of "the curvature of the under surface of the wing") is answerable for the forward course of the descending wing, when struck with energy downwards, it does not necessarily mean that

it has any part in the urging forward of the body of the bird, the wings being joined to the body on movable hinges, can have a motion restricted to themselves, and this property of the curvature is supposed to only influence the descending wing. This may appear to diminish the importance attached to the curvature of the wing, leaving out of view the known greater sustaining capabilities of the concave surface, but without a curvature, that is as plain surfaces only, the wings, in their descent, would take a vertical course; now the centre of support, which is underneath the wings, must accompany the centre of gravity of the flying object to sustain it horizontally, the centre of support lagging behind, as would be the case in a vertically descending wing, would cause the body to swing round it and then direct its course head downwards. This gives a sufficient importance to the propelling property of the wing; though restricted to the wing only, it is seen to be indispensable to flight. That the forward direction taken by the wing is automatic, a result of the action of the air on its under surface may be learnt from the dissection of the wing, which shows no special muscle for this purpose, and that the great muscles, the elevator and the depressor, do not explain it either is easily observed by causing the pectorals of a quite freshly-killed bird to work slowly. Moreover, in free flight, a bird when gradually descending with slowly flapping wing, also when the tendency to fall has been to some extent counteracted by a stored up momentum, as in full flight, the wing does not take a forward direction. In these two last cases the wing is elevated and depressed to a very slight extent; the higher the wing is raised the sooner must it be depressed, as with an upraised wing, the body is almost unsupported and begins to fall; that means that it must be energetically depressed, and not until then does this action of the curvature come into play; so the wing unites in its shape an automatic propelling property, the most favourable sustaining surface, the fitting closely to a body moulded to a form to give the least surface to the resistance of the inertia of the air, availed of by the falcon in its swoop and by the gannets and terns in their head-long dives, also the preservation of that advantageous shape when, on the ground, with wings folded, they may be exposed to a strong wind; a striking example of efficiency gained in the simplest manner. That the forward action of the wing does not drag the body of the bird with it, will receive confirmation in the considertion of the following phases of flight. A kestrel while hovering over a meadow or cornfield is seen to beat its wings in a most energetic manner, and although they have a strongly forward course, the bird does not change its position. A pigeon wishing to reach the eave of the farm building under which it has been feeding, does so by strokes of the wing of the greatest amplitude in a downward forward direction, the forward position of the centre of gravity drawn back as much as possible, the body hangs vertically between the joints of the humerus, and the consequence is, that though with energetically forward descending wings, the flight is vertically upwards, these examples, verified by instantaneous photography, though by no means exhaustive, go to prove that the forward course of the wing does not mean the translation of the body of the bird, though it proves its sustension. As there is no doubt that a bird travels in a forward horizontal direction, or in any direction it pleases, and if this is not due to the shape of the wings nor to the speed at which they may be worked, one must look for something else which is as constant a characteristic of a bird as wings, and which is independent of any eccentricities of appendages. This indispensable quality is recognized as the greater weight of the bird to an equal mass of the medium in which it travels, and this is true of every animal which has chosen the same means of progression; it might conceivably have been otherwise, some might have partially lightened themselves by enormously inflated air receptacles, as is now done in a small degree, to terrify their enemies, by some species of lizards, etc.

It can now be stated that the greater specific gravity of the flying object is the cause both of its horizontal flight, of its descending flight, and partly of its ascending-forward flight; of course the weight of the object or animal that is to fly must be in such a ratio to the sustaining surfaces that they are able to elevate and support it; it is in the weight, that we are to find the explanation of forward flight in as mobile a medium as the atmosphere, in which the first great difficulty is to raise and support a weight, and this must and does appear surprising—the wings being limited to elevating, sustaining and guiding surfaces.

The failure of the balloon to travel in any desired direction, is an argument in favour that a greater specific weight than the surrounding air is a necessity; the balloon being of either less or equal specific gravity to the surrounding air, it has either an elevating or sustaining force; but it is only a bubble floating in or upon a current, and quite de-

Digitized by Google

pendent on that current for its movements. Such a limited power of translation would not suit an animal having to chase or seek its food, and to man, the balloon is of little more use. By those who have made experiments with mechanically driven flying models, weight has been found as necessary as power to raise the model from the ground; it can be seen in the successful free flying models of Professor Langley, L. Hargrave, and Herr Kress, that they have endeavoured not to eliminate weight, but to keep it within reasonable bounds, and to place it in a proper position. This leads to an all important qualification of the above statement "that weight is necessary for forward flight" which is, that "weight in a proper position is necessary." This position is a forward one in the body of the flying object, but how far forward depends on the amount of the support and on the mobility of the supporting surfaces, not merely in taking any angular position, but in amplitude and direction with respect to the position of the forward weight; in other words, an intermittent support. The intermittency of the support is necessary to allow of the position of the centre of gravity to be taken advantage of, otherwise, if the body of the flying objects were continuously supported, either the influence of the position of gravity would be nullified, or if carried far enough forward would merely give the body a list in that direction, but in neither case would horizontal flight be possible; in every phase of a bird's flight is this intermittency of support clearly perceivable, in rowing flight, the intermittency of support is when the wing is raised, which takes about one-third of the duration of the full stroke, and it is to this regularity of intermittency that the high rate of speed can be attained in rowing flight; as momentum is due to the regularity of the recurrence of a motion, it can be equally clearly seen in sailing flight when the bird on outstretched wings is subjected to the intermittent support given by the succeeding air waves, but it is owing to the irregularity of intensity and direction of the air waves that speed in sailing flight is never great.

The short flight and unsatisfactory results of free flying models, which is such a vexation and weariness of spirit to those who have tried to learn anything useful from their flight, is caused by the difficulty of devising means for automatically adjusting supporting surfaces, which would counterpoise at one moment the effect of the weight, at another yielding to it, and again, overcoming it.

A striking example of this play between weight and its support is to be seen by watching a gull advancing against a strong head-wind, slowly floating forward on outstretched wings, which are in closest touch with the instantaneously and constantly changing wind, now with drawing support with half-closed and almost closed wings, and giving full play to its weight as the breeze freshens and as the atmospheric wave ebbs, giving the full support to its grandly outstretched wings, a by no means inspiriting sight, it must be confessed, to the beholder, if he be one who believes and ardently hopes for the solution of the human flight; but there is this to be noticed, that the bird, hovering over a river bearing with its current some of the garbage of a large town, is keenly scanning the surface, and with head turning from side to side; nothing is to be passed that is food. This shows, surely, that the bird's brain is not occupied by the varying intensities of an instantaneously changing support, that all this exquisite balance does not trouble it with a thought. Perhaps this gives some hope that it is not beyond the ingenuity of man to devise as efficacious a combination of weight and support.

It would seem certain that no surface, or grouping of surfaces, can sustain a weight in the air; a fall can be impeded and directed, but not prevented; birds, though provided with the best conceivable surfaces for abstracting support from the air, cannot sustain themselves on outstretched immovable wings; a single wing falls directly to the ground, as do a pair of expanded joined wings separated from the body of the bird. From this it is seen that a wing, in an atmosphere of rest, has no such extraordinary property of sustentation by which it can sustain itself; this support, both for wings and body, is found, either in the forward or upward waves of the atmosphere, more restless even than the great masses of water, which, meeting the under surface of the wing, give up their energy of movement, which directed against the influence of gravity, is sufficient to counteract or more than counteract it, or by muscular energy the wing strikes the air with a speed which, as it were, surprises it into not yielding quickly and the result is a re-action nearly equal to the energy used. In both cases the direction of flight is the direction of the diagonal of the parallel composed of the downward forward force of the centre of gravity and the upward re-action or thrust expressed in the centre of pressure under the wings.

The importance of this position of gravity is seen by the fact that all else is subordinate to it—it determines the speed, therefore the frequency of the beat of the wings. It is not the frequency of the beat of the wings that causes speed, but speed that causes the frequency of the beat of the wings, in other words, the necessity that the wings are under of furnishing a sufficient support in the right direction to a body which by the intermittency of this support has begun through the influence of the position of its centre of gravity to fall forward: to this is due all the different modes of flight.

In the *natatores* the position of the centre of gravity is far forward, corrected, when on the ground by arching the neck backwards. It is so far forward that sailing flight is impossible, and the wings have to be used at a high rate of speed, to give the necessary support, and to disturb the position of that support by as short an interval as possible; the shape of the wings governed by the necessity for speed, are narrow and sharp-pointed, giving the weight of the anterior edge the more preponderance. These birds also have no tail to, in any way, disturb the influence of the position of the centre of gravity; in these birds we see the perfection of rowing-flight.

The *raptores*, on the other hand, are what may be called evenly-balanced birds, a short neck opposing a largely developed tail, the centre of gravity is in but a slightly forward position, their broad wings, nearly the half of their length, are used deliberately, and they are amongst the best sailors; a proportionally large surface being necessary to the flyer relying on the irregular pulsations of the air.

In the first moments of flight, when the bird's efforts are to gain a forward motion, so necessary in order that the wings be carried past the layer of air already disturbed by its stroke on to another which has its inertia to yield, as a re-action or support. In this endeavour the forward position of gravity is of high importance, before momentum can have been acquired, as few birds can raise themselves vertically from the ground; the larger the bird, the less have they this power; the vulture is a fast prisoner in an enclosure, such as a hedge, which prevents it from commencing its flight with a preparatory run. The great amplitude with which the wings are used, when rising from the ground, gives the opportunity to the forward position of gravity to exert its full influence.

The relations between the position of gravity and its support, as they exist in the bird, must be allowed to have this important rôle in flight, viz., that of enabling it to take any desired direction in the air, to which is lent the more probability from the fact that nature generally makes a virtue out of necessity, and in this case has made a virtue out of the intermittent support necessary to the reciprocation of the wing and of the intermittent support afforded by the atmospheric waves and of the greater specific gravity of the flying object. On a first consideration these would certainly appear unpromising means by which flight could be effected; but if nature has thus employed these simple means which are always to hand, to bring about flight, they are deserving of the closest study of the inventor.

With the above views in mind a cursory examination of the various means proposed to enable man to fly will conveniently close this paper. It would seem that if aerial screws are used, vertical screws are only necessary, having a feathering action insuring intermittency of support. If wings, proportionally similar to birds, they must have energy in command to be sure of sustention. It cannot be disregarded that, by this method, finality must be soon reached, though it is probable that it is destined to play the most important role in the infancy of man-flight; balloons and machines with immovable aeroplanes are not practical, but much could be said in favour of a machine that could be partially lightened by means of gas if its bulk could be brought within practical bounds. It will probably not be disputed that if man weighed only 10 lbs., he would have flown long ago; but it is because he weighs usually between 150 and 250 lbs. that, though flight has been a cherished idea for centuries, it has not yet been accomplished. This ought to make those pause before they commit themselves to the belief of the possibility of airships, atlantic-liner size, going at lightning speed through the air.

Koch's Flying Machine.

Herr Koch, who has been experimenting in aerodynamics and with aerial propellers for many years past, has just completed a large model, which is on exhibition in Munich. The machine has two pairs of superposed aeroplanes and a tail, with a large propeller, on the feathering paddle-wheel principle, in the centre. He proposes eventually constructing an apparatus with a total area of about 100 square metres, and a total weight of 600 kilos., provided with a 4-cylinder benzine motor of 24 horse-power.

Wind Averages.

The following tables are extracted from a very interesting paper by Mr. Mossman, published in the Journal of the Royal Meteorological Society :—

TABLE IX.

DIRECTION OF THE WIND AT GREENWICH FROM 1841-90, DEDUCED FROM HOURLY OBSERVATIONS. MEAN NUMBER OF HOURS THE DIRECTION WAS—

Months.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	60·6	72·8	40·6	58·8	100·0	238·6	91·0	34·3	47·3
February	71·0	85·1	50·0	40·5	71·4	198·3	81·5	40·5	39·4
March	93·7	106·7	68·5	45·1	57·3	182·9	91·0	59·0	39·8
April	88·4	132·7	91·8	46·9	58·2	156·1	70·4	46·9	28·6
May	97·3	147·9	77·1	42·8	60·9	183·5	65·8	33·5	35·2
June	88·2	90·0	56·2	40·0	55·9	219·6	94·6	46·6	28·9
July	74·0	72·8	36·3	27·7	63·5	264·0	115·1	51·7	38·9
August	68·4	68·7	43·3	34·9	62·6	256·8	110·6	47·6	51·1
September	71·0	100·2	47·4	43·8	61·1	212·1	89·6	34·3	60·5
October	73·4	73·4	50·2	54·0	79·8	212·4	98·5	45·3	57·0
November	89·1	78·3	50·4	50·5	80·3	201·1	78·0	47·8	44·6
December	69·9	61·4	44·5	48·0	77·2	235·2	106·4	45·6	55·8
Total	945·0	1090·0	656·3	533·0	828·2	2560·6	1092·5	533·1	527·1

TABLE X.

DIRECTION OF THE WIND AT GREENWICH, 1841-90. MEAN NUMBER OF DAYS IT BLEW FROM THE FOLLOWING DIRECTIONS :—

Months.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	2·5	3·0	1·7	2·5	4·2	9·9	3·8	1·4	2·0
February	2·9	3·5	2·1	1·7	3·0	8·3	3·4	1·7	1·6
March	3·9	4·4	2·8	1·9	2·4	7·6	3·8	2·5	1·7
April	3·7	5·5	3·8	2·0	2·4	6·5	2·9	2·0	1·2
May	4·1	6·2	3·2	1·8	2·5	7·6	2·7	1·4	1·5
June	3·7	3·7	2·3	1·7	2·3	9·1	4·0	2·0	1·2
July	3·1	3·0	1·5	1·2	2·6	11·0	4·8	2·2	1·6
August	2·9	2·9	1·8	1·4	2·6	10·7	4·6	2·0	2·1
September	3·0	4·2	2·0	1·8	2·6	8·7	3·8	1·4	2·5
October	3·1	3·1	2·1	2·2	3·3	8·8	4·1	1·9	2·4
November	3·7	3·3	2·1	2·1	3·3	8·4	3·2	2·0	1·9
December	2·9	2·6	1·9	2·0	3·2	9·8	4·4	1·9	2·3
Total	39·5	45·4	27·3	22·3	34·4	106·4	45 5	22 4	22·0

TABLE XI.

DIRECTION OF THE WIND AT GREENWICH, 1841-90. MEAN PERCENTAGE FREQUENCY.

Months.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	8·1	9·8	5·5	7·9	13·4	32·1	12·2	4·6	6·4
February	10·5	12·5	7·4	6·0	10·5	29·3	12·0	6·0	5·8
March	12·6	14·3	9·2	6·1	7·7	24·6	12·2	7·9	5·4
April	12·3	18·4	12·7	6·5	8·1	21·7	9·8	6·5	4·0
May	13·1	19·9	10·4	5·7	8·2	24·7	8·8	4·5	4·7
June	12·2	12·5	7·8	5·6	7·8	30·5	13·1	6·5	4·0
July	9·9	9·8	4·9	3·7	8·5	35·5	15·5	7·0	5·2
August	9·2	9·2	5·8	4·7	8·4	34·5	14·9	6·4	6·9
September	9·9	13·8	6·6	6·1	8·5	29·5	12·4	4·8	8·4
October	9·9	9·9	6·7	7·3	10·7	28·5	13·2	6·1	7·7
November	12·4	10·9	7·0	7·0	11·1	27·9	10·8	6·6	6·3
December	9·4	8·2	6·0	6·5	10·4	31·6	14·3	6·1	7·5
Total	10·8	12·4	7·5	6·1	9·4	29·2	12 5	6 1	6·0

Digitized by Google

TABLE XII.

Showing the Number of Days of each Wind in London from 1763-1897.

Months.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	337	405	229	337	567	1336	513	189	270
February	391	472	283	229	405	1120	459	230	216
March	526	594	378	256	324	1026	513	337	230
April	499	742	513	270	324	877	391	270	162
May	553	837	432	243	337	1026	364	189	202
June	499	499	310	229	310	1228	540	270	162
July	418	405	202	162	351	1485	648	297	216
August	391	391	243	189	351	1444	621	270	283
September . . .	405	567	270	243	351	1174	513	189	337
October	418	418	288	297	445	1188	553	256	324
November . . .	499	445	283	283	445	1134	432	270	256
December . . .	391	351	256	270	432	1323	594	256	310
Total . . .	5327	6126	3682	3008	4642	14,361	6141	3023	2968

TABLE XIII.

Percentage Frequency of Gales with Different Winds, 1763-1897.

Months.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	7·1	3·5	10·0	2·4	8·6	8·2	18·7	9·0	
February	5·1	2·5	3·9	0·4	13·1	6·8	19·4	8·3	
March	3·2	3·0	9·8	0·0	9·7	8·0	19·3	6·5	
April	3·0	2·3	3·3	0·6	7·7	4·5	10·2	2·6	
May	2·4	2·3	3·0	0·4	5·7	3·9	7·4	5·3	
June	1·2	0·8	0·6	0·4	2·9	2·9	7·4	2·2	
July	1·0	0·5	2·5	1·9	4·3	2·9	6·2	2·0	
August	2·3	0·5	2·5	1·6	6·3	2·1	6·9	1·5	
September . . .	1·5	0·2	3·3	1·2	8·8	4·2	7·6	1·3	
October	2·4	0·7	4·2	1·0	7·4	5·1	15·0	3·9	
November . . .	3·8	2·5	4·6	2·1	10·3	7·8	15·0	4·4	
December . . .	4·9	2·6	8·2	1·5	14·4	8·4	14·0	6·2	
Total . . .	3·04	1·83	4·59	1·20	8·51	5·29	12 11	4 58	

General Mean, 5·11.

NOTES.

Kite-Flying Record.—Again the world's record for kite-flying for scientific purposes has been broken at the Blue Hill Observatory. On February 28th, 12,440 feet above the sea level was reached by a recording instrument attached to a string of tandem kites. This is 365 feet higher than the preceding best record, made at the same place on August 26th. The flight was begun at 3.40 p.m. Tuesday, the temperature at the surface being 40 degs. and the wind seventeen miles an hour. At the highest point the temperature was 12 degs. and the wind velocity fifty miles an hour. Steel wire was used as a flying line, and the kites, four in number, were of an improved Hargrave pattern, with curved surfaces, made after the pattern of soaring birds' wings. The upper kite carried an aluminium instrument weighing four pounds, which recorded graphically temperature, wind velocity, humidity and atmospheric pressure. The combined kites had an area of 205 square feet and weighed twenty-six pounds, while the weight of the wire was seventy-six pounds. The upper kite remained above two miles for about three hours, and was reeled in by a steam windlass, constructed for that purpose. When within half a mile of the ground, the fastening on one of the kites slipped, and this carried it up to the one above, the added pull snapping the wire and sending three kites adrift. A search for the lost kites was begun on Wednesday, and two of them were found at the Milton town farm, about two miles away,

but the third was not recovered until yesterday, when it was found at Field's Corner, over six miles north of the observatory, or more than half the distance between that point and the State House. The recording instrument was found uninjured. This was the last of a series of five high flights made on successive days, Sunday excepted. The average height reached was 10,300 feet, or nearly two miles. The temperature at 10,000 feet on February 23rd was 5 degs.; on the 24th. 1 deg.; on the 25th, 11 degs.; and on the 28th, 20 degs. above zero.

Sailing Balloons. — According to M Hervé, the eminent aeronaut, the invention of a steering sail for balloons, which the newspapers have ascribed to Andrée, dates as far back as 1784, when Professor Kratzenstein, of Copenhagen, some months after the invention of balloons, pointed out that one could use such a sail. Others, and notably Green, the English aeronaut, also considered the steering sail and guide rope. Hervé himself got a deviation of the balloon of 65 to 70 degrees by using this means in 1886. Andrée (1895-97) only obtained a deviation of 10 to 12 degrees. M. Hervé, in conclusion, remarks that such devices can only be regarded as helps, not as the instruments of a regular process of aerial navigation, and that to attempt vast explorations with the possibility of deviating only 10 to 12 degrees appears to him an enterprise as bold as it is inconsiderate.—*The Globe.*

Seventy Miles an Hour for 420 Miles.—A remarkable balloon voyage has been accomplished by three Prussian officers. They left the Tempelhofer-field, Berlin, a few minutes past ten in the morning, the weather being bright, and a strong wind blowing. They crossed the Austrian frontier at a height of 5,200 feet. They were soon over the foothills of the Carpathians, and at four o'clock they landed at Baguska, in Galicia. As the crow flies, Baguska is 420 miles from Berlin. The average travelling would be therefore over seventy miles an hour.

Descent in the Sea.—Madame Charly, the well-known aeronaut, had a narrow escape from death recently. According to a telegram from Nice to the "Petit Journal," she had made an ascent at Beaulieu, and the balloon was carried by the wind towards the sea. Madame Charly opened the valve, and the balloon began to descend very rapidly. Some fishermen went to the balloonist's rescue, and picked her up just as she reached the water.

Artillery versus Balloon.—Recently the German artillery practice with the new quick-firing gun demonstrated that the captive balloon was worthless in warfare when used in the day time. If it can be made available at all, it must be under cover of night, otherwise its shrift is likely to be very short. The German kite balloon was kept moving at an altitude of 600 meters. The guns trained upon it were located 3,000 meters distant. After the third discharge of the rapid-firing battery, the range was found. It was then all over with the balloon, for every shot fired at it reached the mark. It was pierced in all directions and finally set on fire, when it, of course, came quickly to the ground.—*Newcastle Journal.*

M. "Duruof."—The death is announced at Erquelines (Aisne), at the age of 56, of M. Jules Dufour, known as the aeronaut Duruof. He began his ascents with Nadar in 1865, and both of them during the siege of Paris constructed balloons for the Government. At the end of September he made an ascent from Paris with despatches, and alighted near Evreux, but, of course, was unable to return. In 1874, in an attempt to cross over to England from Calais, he and his wife narrowly escaped drowning. He lived latterly on a small Government pension.

A Model Air Ship.—A model of an air ship on the aeroplane system has been constructed by Dr. Barton, of Beckenham. It is a boat-shaped car with wheels underneath it, suspended from a cylindrical balloon, 21 feet long. Between the balloon and the car there is a horizontal aeroplane consisting of a thin flat board, which can be inclined as required. A screw propeller, actuated by clockwork, is fitted to the car. When the balloon is inflated, the aeroplane is sloped upwards in front, the screw is set in motion, and the ship runs on its wheels until it rises. To lower the ship, the aeroplane is sloped in the opposite direction. An experimental run which was conducted in the presence of Colonel Yorke was, on the whole, successful. The machine first ran on the ground upon wheels, then rose and made its way over the lawn-tennis grounds which had been chosen for the theatre of the demonstration. Apparently it cannot go against the wind, but it is evidently capable of being directed more closely than the ordinary balloon.

A new Balloon Gun has been invented. It is mounted on a waggon, and so placed upon "universal" bearings as to be aimed instantly at any point from zenith to horizon. After the

Digitized by Google

manner of the machine weapon, it throws a continuous stream of projectiles, like water turned on from a hose, and no gas bag exposed to its discharge for many moments could possibly stay aloft. The projectiles are conical and of solid steel, having no bursting charge, and weigh a pound apiece. A hollow conical stand fastened to the floor of the waggon supports the gun, the arrangement being such that when it has to be aimed directly upward the marksman must lie beneath it. Its effective range is a mile and a quarter.

A Swiss Dirigible Balloon.—The balloon is shaped like a fish or boat, and is 16 metres long, 4 wide, and 8 high. Its concavity contains about 300 cubic metres. Inside there is a wooden frame covered with aluminium plates rivetted together and cemented. Three specially constructed lamps, in the lowest part of the concavity, supply the balloon with warmed and, consequently, rarefied air, to raise the weight, which is reckoned at 1,000 kilogrammes, including the two aeronauts. Right and left outside the vessel two windmill-like sails, having a surface of two square metres, are set, which can be propelled by hand from the driving chamber. The screw sails, together with the rudder at the after part of the balloon, should enable it to be turned as desired From a valve fixed on the top cold air can be let into the balloon, thus causing it to descend. This interesting construction is almost ready, and Herr Weisenrieder will shortly make an ascent.

Gyration of Aerial Machines.—Count J. Carelli has recently been writing several interesting articles in *La France Aerienne*, and elsewhere on the above subject. This action, caused by the minor currents of the atmosphere, is frequently noticeable in ordinary balloon ascents, and has proved a difficulty in the trials of propelled balloons. Count Carelli states that "a body immersed in a fluid turns more easily as the fluid is less dense," and therefore is more noticeable in air than in water. He has recently devised an apparatus which he terms "a dirigible parachute," to experiment on means for overcoming this tendency. In the centre of this is fitted a disc to be rapidly rotated, and the centripetal force thus created should preserve the balance. The model tested was in the form of a curved rectangle, about 5 ft. by 2 ft., with a propeller behind and a gyroscopic disc in the centre worked by clockwork. The results of the experiments are said to be very satisfactory, the model remaining perfectly horizontal during its descending flight.

Recent Publications.

"Soaring Machines." By L. Hargrave. (Reprinted from the Journal of the Royal Society of N.S.W.) Another interesting account of experiments with models of a new form. We shall hope to be able to reproduce this article in a future number.

"Grundlagen der Lufttechnik." By Max Lochner. (Berlin: W. H. Kuhl, 1/6.) A popular treatise on a new theory for the solution of the question of flight and the problem of dirigible balloons.

"Studies of Cyclonic and Anti-Cyclonic Phenomena with Kites." H. Helm Clayton. Blue Hill Meteorological Observatory, with tables and diagrams.

"Progress of Experiments with Kites during 1897-98 at the Blue Hill Meteorological Observatory." S. P. Fergusson. With illustrations and diagrams.

Foreign Aeronautical Periodicals.

L'Aeronaute (Paris).

January.—Séances du Comité d'Aérostation pour l'exposition de 1900—Ascension de l'Alliance (6 planches)—Compte rendu technique du ballon captif de Turin, par M. Louis Godard—Ascensions exécutées a l'aérodrome, par l'Aérostatic Club—Correspondence.

February.—Compte rendu du Comité de l'exposition de 1900—Lettre au Ministre de Affaires Etrangeras sur l'interdiction des ballons en temps de guerre—Ballon dirigible de M. Danilewski (2 planches, photographiques)—Société française de Navigation aérienne.

March.—L'inconstance Solaire, M. Hauvel—Etude de la haute atmosphère—M. de Fonvielle—Rapport sur le Moteur Paloux*—M. Cassé—Société française de Navigation aérienne — Nécrologie, Jules Dufour — le General de Bouedec.

* This is on the principle of the Turbine, using either steam or petroleum vapour.

Digitized by Google

La France Aerienne (Paris).

January 1-15.—Lettre ouvert au Comte Carelli: C.Jobert—Humorismé aéronautique: Comte Carelli.

January 15-31.—De la Giration dans l'Air—Compte rendu technique du ballon captif de l'exposition de Turin—Academie d'Aérostation Météorologique—Tableau de diverses vitesses.

February 1-15.—Aéronautique théorique et practique — Comte Carelli — Académie d'Aérostation Météorologique—Tableau de diverses vitesses (suite and fin).

February 15-28.—La France Aérienne en Amérique.

March 1-15.—Ballon dirigible et boulet de cannon, Comte Carelli—Nécrologie, Duté Poitevin—l'Aéronautique en Italie—Météorologie Populaire, Pronostics du Temps.

March 15-31.—A la Conquète de l'Air C. Jobert—Aéronautique au jour le jour: Comte Carelli—Nécrologie, Jules Dufour (Duruof)—Expériences exécutées avec un parachute dirigible du Comte J. Carelli (illustrated)—Action Simultanée de plusieurs aérostats comme nouveau systéme de Navigation aérienne, M. Sigaline.

Zeitschrift fur Luftschiffahrt (Berlin).

January.—Abschiedswort: A. Berson (Dr Berson has given up the editorship of this journal, and Herr Karl Milla, of Vienna, has succeeded him)—Zum Eintritt, K. Milla—Jäger, Zur Frage des Widerstandes, welchen bewegte Korper in Flussigkeiten und Gasen erfahren—V. Loessl—Der Aërodynamische Schwebezustand einer dünnen Platte—Kleinere Mittheilungen.

Illustrirte Aeronautische Mittheilungen (Strassburg).

January, 1899. — Versuche mit neuen Registrir-Drachen, von Hugo L. Nickel—Der automatische Flug mittels des Kress-Fliegers, von Arnold Samuelson—Die Militarluftschiffahrt in England, von H. W. L. Moedebeck—Einige Erfahrungen aus den Freifahrten des Jahres 1898, von Hinterstoisser—Die Ballonfahrt über die Alpen am 3 Oktober 1898—Kleinere Mittheilungen: Bau der russischen viereckigen Drachen, von Hüther; Der hochste Drachenaufstieg, von A. Lawrence Rotch; Lamson's Drachen; Das Luftschiff von de Santos Dumont; Die Luftschiffahrt auf der Weltausstellung zu Paris im Jahre 1900; Bericht uber die Thatigkeit der Abtheilung fur Luftschiffahrt auf dem X. Kongress der russischen Aerzte und Naturforscher in Kiew im Jahre 1898, von A. Kowanko—Aus unseren Vereinen—Aus anderen Vereinen—Patente in der Luftschiffahrt—Eingegangene Bucher und Separatdrucke — Zeitschriften-Rundschau — Aus anderen Zeitschriften—Neue Nachrichten—Personalien—Briefkasten.

Notable Articles.

Jan. 1899. *Geographical Journal.*—"A new Mountain Aneroid Barometer." E. Whymper. An important communication dealing with the errors of ordinary aneroids for measuring heights.

6. *Daily Telegraph.*—"Ships of the Air." General account of the progress of aeronautics during recent years.

7. *Golden Penny.*—"Adventures in the Air." By S. Spencer. The Sensations of Parachuting. (Illustrated from photographs.)

7. *Adelaide Observer.*—"Modern Balloons."

14. *Golden Penny.* — "Adventures in the Air." By Stanley Spencer. Illustrated account of the high ascent with Dr. Berson.

20. *English Mechanic.*—"Danilewski Dirigible Flying Machine." (Illustrated.)

Feb. *Pall Mall Magazine.*—"European Military Ballooning." A. Delmard and R. Blathwayt. (Illustrated.) Gives an account of the French establishment at Meudon, and the navigable balloon "La France," followed by a description of the English establishment. The article is full of inaccuracies; thus plate V. represents Debayeux's balloon, not "La France." The motor used in the latter does not weigh "four times less than any other known combination used in attemps to navigate the air." The English "Balloon Corps" is at Aldershot, not Chatham, and the hydrogen produced there is from zinc, not iron. The story of the Boer Campaign is amusing from its errors. Finally it is said that "the Germans do not appear to take much interest in this science"!

Digitized by Google

Feb. 4. *Revue Scientifique.*—"Les ballons à deviateurs." H. HERVE.

4. *Invention.*—"A Nearly Successful Flying Machine." Danilewsky's Dirigible Balloon. (From *Aeronautical Journal.*)

10. *English Mechanic.*—"Myer's Sky Cycle."

12. *Manchester Sunday Chronicle.*—"Balloons in War and Peace." Sailing balloons, &c. (Illustrated.)

16. *Standard.*—Leading article on Scientific Ballooning.

17. *Westminster Budget.*—"The Fate of Andrée."

18. *Society.*—"Ballooning."

18. *Penny Magazine.*—"Aerial Photography."

22. *Electrical Review.*—"Experiments with Kite Electric Collectors." W. A. EDDY.

Mar. 11. *Graphic.*—"Military Ballooning at Aldershot." With photographs of model Kite-balloon.

11. *Pearson's Weekly.*—"Shall we Fly in 1900?"

12. *New York Herald.*—"Flying Machines." (Illustrated.)

21. *Scotsman*—"The Exploration of the Atmosphere by means of Kites.

Applications for Patents.

(*January, February, March*, 1899.)

2,257. February 1. H. SUTER, Manchester. **Improvements in Air Ships.** (*Complete.*)

3,116. February 11. J. P. GIVORD, London. **Advertising Balloon or the like.**

3,637. February 18. A. H. P. BLUNT, London. **An Improved means of Aerial Sailing.**

3,892. February 21. R. M. BALSTON, London. **Improvements in Flying Machines.**

5,094. March 8. E. BAKER, London. **Improvements in or connected with Navigable Balloons or Flying Machines.**

5,418. March 13. F. A. BARTON, Beckenham. **An Improved Aerial Machine or Air Ship.**

Patents Published.

18,935. August 16, 1897. **Flying Machines** HARDACRE, G., Lower Bucca, New South Wales.

The frame consists of a vertical standard having a spring base and carrying a motor, a platform propeller gas bag, and a pair of wings with articulating bars. A second standard, to which is attached an aeroplane, can slide in guides upon the standards, and is reciprocated by the motor. The propeller is driven through gearing and connecting rods. The wing arms are pivoted on a cross-bar.

18,992, 19,301, 20,434, 20,909, and 21,308 are abandoned.

21,355. September 17, 1897. **Steering Balloons.** BROOKES, A. G., 55, Chancery Lane, London.—(*Bagge, P. I.; Risor, Norway.*)

There is a sail with a horizontal cylinder having its axis in the plane of the sail. A fan at the rear end of the cylinder causes the balloon to travel through the wind in a rearward direction, and produces through the cylinder a current which acts on an adjustable rudder tending to keep the sail slightly inclined to the wind, and consequently to cause the balloon to move sideways.

23,563, 23,655, and 24,133, abandoned.

24,532. October 22, 1897. **Flying Machines.** DANILEVSKY, C., Hydropathic Institute, Veterinary Street, Kharkow, Russia.

From an aerostat of not quite sufficient buoyancy to support a man in the air, is suspended by cords a frame carrying a saddle and wings. The aeronaut is supported on the saddle, and with his arms and feet works the wings. One of the cords is attached to a winch and can be varied in length, so that at starting the aeronaut is in a vertical position and can run along the ground on stilts, while, when he has ascended, by lengthening the forward cord he can assume an inclined or a horizontal position. The inclination of the axis of the aerostat may also be altered by shifting the position of the pulley by which the aeronaut is suspended by means of cords. The wings have main arms of bamboo, pepper-vine or the like, made in short pieces hinged together by spring hinges, so that the arms can bend on the up-stroke; the transverse arms are prevented from becoming inverted by cords. The wings are supported by a spring. The direction of the wings may be varied by a lever working over a slotted disc.

24,590, abandoned.

26,391. November 12, 1897. Aeronautics; road vehicles. WOLFF, CARL, BARON VON, Dresden, Dornblüthstr. 1B.

For raising and propelling aerial machines, or assisting in the propulsion of road vehicles, a number of arms on an axle, driven by a motor or from the wheels of a vehicle, are provided with jointed extensions carrying weights at the end. Opposite extensions are connected together by pulleys and bands, so that on one side they are opened outwards and on the other drawn in against the axle by a pulley acting upon a lever as the apparatus is rotated. The direction of motion or of the force exerted is stated to be that in which the centrifugal power produces its principal effect, and this direction can be altered by shifting the position of the axle of the pulley in the slotted arm of the standard. In one modification, weighted levers are pivoted to a cross-piece and are allowed to swing outwards, during a portion of their rotation round the axis, by means of a surrounding cam-box. In another modification, opposite weights are mounted on the same rod, which slides in guides across the axis, the weight at one end being guided by a curved race.

28,810, abandoned.

United States Patents.

621,195. Navigable Balloon. F. G. ZEPPELIN. Stuttgart, Germany.

Framework divided into compartments, with gas bag in each, also auxiliary gas bags for manœuvring. Adjustable weight to preserve balance. Foremost balloon provided with driving mechanism.

621,593. Kite. WALTER S. BAKER, Newark, N.J.

Diamond-shaped kite. Two sticks with slots at ends to take cords fixed to the sides of the covering. Longitudinal pocket for backbone.

French Patents.

280,021. LOCHNER. Improvements in Aerial Vehicles.

280,582. LAUGHLIN. Improvements in Apparatus for Elevating and Propellers for Aerostats.

280,593. LANGE. Dirigible Air Ship.

280,698. KOBYLANSKI. Dirigible Air Ship.

281,310. DUPUIS. Direction of Aerial Machines by the Combination of Heavier and Lighter than Air.

282,353. CZARNIAKOWSKI. Pneumatic Screw to solve the Problem of Aerial Navigation.

Digitized by Google

620.5
A2.45

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4 1910

THE AERONAUTICAL JOURNAL



No. 11. JULY, 1899. VOL. III.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	49
THE AERONAUTICAL SOCIETY OF GREAT BRITAIN (*Illustrated*)	49
ON FLAPPING FLIGHT OF AEROPLANES (*Illustrated*). MAURICE F. FITZ-GERALD	59
SOME SIMPLE EXPERIMENTS WITH AERO-CURVES (*Illustrated*). A. A. MERRILL	65
NOTES: AERONAUT'S ADVENTURE—KITE EXPERIMENT ON WAR SHIP—STRANGE ACCIDENT TO A BALLOON—NAVAL BALLOONING—THE ANDREE EXPEDITION—THE ANDREE SEARCH EXPEDITION—PARIS EXHIBITION OF 1900	67
FOREIGN AERONAUTICAL PERIODICALS	69
NOTABLE ARTICLES	71
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED—FOREIGN PATENTS, &C.	71

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCALLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JULY, 1899.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICES OF The Aeronautical Society.

Meetings of the Council were held on April 26th and on May 27th, when the following gentlemen were elected Members of the Society:—

Mr. JOSEPH CLARKE, A.I.E.E., Metropolitan Electric Supply Co.
Mr. DAVID M. B. SMYTH, Cuckfield.
Mr. F. W. DICKINSON, Leeds.
Mr. ALFRED WALKER, Bradford.
Sr. D. FRANCISCO INESTA, of Daimiel, Spain.
Dr. F. A. BARTON, Beckenham.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

It has been decided to hold a meeting of the Society on July 28th, at the Society of Arts, when it is hoped that working models will be exhibited by

Dr. Barton—Navigable balloon with aeroplane.
Mr. Smyth—Aeroplane with new form of propeller.
Mr. Broadwell—Vertically lifting revolving aeroplanes.
Mr. Cochrane—Valvular wing action driven by compressed air engine.

The Aeronautical Society of Great Britain.

A meeting of the above Society was held at the Society of Arts, John Street, Adelphi, W.C., on Friday evening the 26th May, under the presidency of Mr. Percy S. Pilcher. With Mr. Pilcher, on the platform, were Captain Baden-Powell, the Honorary Secretary of the Society, and Mr. Lawrence Hargrave, the gentleman so well-known to all interested in the science of Aeronautics, and whose name, in connection with his Flying Machine, has lately been brought very prominently before the public notice by more than one London paper. It was to hear Mr. Hargrave's paper on Kites and Soaring Machines that the Meeting had been convened. There was a large attendance, and previous to the commencement of the Meeting, much interest was shown in the model of Mr. Hargrave's soaring machine and also in his kites, a number of which had been erected in the hall.

In opening the proceedings the Chairman said that he wished to introduce the Meeting to Mr. Lawrence Hargrave (Applause), whose name they had doubtless heard, and who had been in the papers of all nationalities in regard to the most interesting experiments which he had made in kites and kite-flying. Mr. Hargrave, continued the Chairman, has lately obtained some most wonderful results. I am glad he has photographs with him, otherwise we should have great difficulty in believing some of the startling facts which he will tell us, and of which he will be able to produce the photographs. Mr. Hargrave is the modern inventor of what is now called the "Box" kite, which takes its form from an old Chinese pattern. The type has been revived really by Mr. Hargrave, although we continually see reference to it in American papers as an American invention. It is used by a great many American kite-flyers, and I think among others by those who have got high altitudes at Blue Hill Observatory. I will now call upon Mr. Hargrave to address the Meeting.

Mr. LAWRENCE HARGRAVE (who was received with applause) said:—

This box of kites has been brought to London with the hope that they would be

Digitized by Google

of interest to those who believe that flying and soaring machines will be soon made and used. I noticed in one of our Aeronautical Journals that there was not a specimen of a Hargrave kite in England. Here are some that I can vouch for as being genuine samples: and I will proceed to describe them.

Passing over the endless variety of paper, cardboard, wood, tin, and aluminium kites that have been tried during the last 6 years, many of which have been more or less faithfully illustrated in the Journal of the Royal Society of New South Wales, with the intention that all men should derive equal benefit from their use, we come to the two-equal-celled species as an example of the survival of the fittest.

The kites used by Rotch at Boston are about the same size and proportion as these 40-foot ones, but they are not made to fold up as Blue Hill Observatory has ample stable accommodation.

I hope particular notice will be taken of the various joints and fastenings. I pride myself on making every detail as simple and light as possible. It is unceasing attention to apparent trivialities that insures success.

A good deal of redwood was used for the earlier kites, but now I prefer Oregon. I should not use heavier wood, even if strong straight-grained stuff such as ash was easily procurable.

The spars of the large kite are approaching the dimensions that require tubular constructions of the 8 jack-yards and two fore-and-aft of material.

Much praise has been lavished on bamboo, but I have never seen a sample that I would work into a kite.

The kites are all covered with common calico; only one very small one has been made of silk. I think silk is not suitable for any kites of these sizes; balloon silk would be too strong, and therefore useless weight would have to be carried, and if you used a lighter silk its elasticity would be highly detrimental. Silk might be the best material for the cover of a kite that had about 200 square feet of lifting surface.

Large kites are not to be recommended, they are not efficient per square foot or per pound weight as small ones.

The edges of the calico covers are hemmed and strong fishing line run through. The two covers are rove on a horizontal spar and a board laid in their lower loops. Weights are placed on the board till the fabric is stretched evenly. The pieces of fishing line are then secured permanently, so that when the kite is finished there will be no shivering surfaces.

A measuring tape is passed round each hem before the weights are removed, and the position to obtain the greatest strength per pound sticks are marked. This process ensured exact parallelism and rectangularity of the completed structure.

The continuous diagonal struts boom out the lower jack-yards and the cut diagonals keep the upper corners out, and when the centre tackles are set up the kite is perfectly rigid. All the bevelled ends of the struts are truly cut in a bevel-box so that they fit exactly to their respective seats without any trimming.

The centre tackles of the forward cells transmit all the strain of the flying line when a tandem is used.

The kite with the two main spars parallel horizontally instead of vertically, is a noteworthy structure. It has the disadvantage of requiring more care in unfolding than the other ones.

The action is practically the same as opening four four-ribbed umbrellas simultaneously. On the other hand the furled length is shorter, there are no loose pieces, and the total weight is less.

As to the most economical size of kite to use for any purpose, I think that those with a horizontal surface of 20 square feet are the best, they can be made to weigh one ounce per square foot, and may be depended on to lift one pound per square foot in a 20-mile breeze; that is, one ounce of material lifts fifteen ounces of load.

A late American publication ("Live Steam," January, 1899) states that the Blue Hill kites also lift one pound per square foot in a 20-mile wind.

The American copies of my cellular kites have no diagonal struts, the corners being pushed out by horizontal and vertical pieces of wood. In addition they require to be guyed in every direction by steel-wire stays.

This style appears to me barbaric. Horizontal pieces of wood adjacent to the horizontal or lifting calico surfaces must impair their efficiency. However tightly the calico may be stretched the cobweb of wire stays used to keep the affair cubical must tend to slacken it. Again, if all is perfectly square and rigid before the kite is flown, the moment the wind blows on the calico half the wire stays must slack up and allow the instrument to assume a rhomboidal form.

Elastic slings have been used in America, they add to the complication but keep the kite at a more efficient angle in light winds. Arched ribs increase the lifting power of the kite, and improve the set of the canvas.

Digitized by Google

The flying of cellular kites is a very simple process, you hold the string in one hand and the kite in the other; watch for a chance, let go the kite and pay out the string. There is absolutely no assistance required till the strain is more than you can hold, and even then by under-running the line the lowest kite of a tandem may be safely landed. A winch, of course, would be a very useful adjunct to a kit of man-lifting kites.

As each kite is added to a tandem the team increases in steadiness, there is no yawing and darting about; therefore fly the smallest one first from a position where the wind is steadiest, then take the line to leeward of a clump of trees, or into a pit, and attach as many more as you require, undisturbed by gusts of wind or flying sand.

When furling a cellular kite, the tackles are eased up first, the struts unseated and folded parallel to the jack-yards, and all the sticks laid together. Then the calico is rolled round the sticks and secured with a gasket.

The compactness of the outfit may be judged from the fact that all these, with a total lifting surface of upwards of 300 square feet, do not nearly fill that box.

The object of elaborating this system of kites was not to enable me to elevate myself to view the surroundings, and, as a matter of fact, I have only been up a few times to an extreme height of 20 feet, but to obtain a stable and reliable set of superposed aeroplanes for a flying machine.

It now remains to make a motor sufficiently powerful to thrust the aeroplanes to windward so as to slack the kite line; and, as many of propeller, the weight, and the tail.

I now come to the question of soaring, and what that wooden thing with the heavy lead weight does.

Some of us believe the form of a soaring bird's wings is such that sufficient power is extracted from a volume of disturbed air moving in a horizontal direction to not only support the bird, but to raise it without the expenditure of any muscular energy.

Of course this is incredible to those who have not watched a soaring bird, and who believe that our text books contain the mechanics of all existing things.

The Aeronautical Society of Great Britain has been good enough to reprint several of my papers on this subject, in which I have endeavoured to make clear how a curve similar to a soaring bird's wing pushes towards the wind that blows on its convex surface.

My mathematical knowledge is insufficient to figure out that the experiments only show what was to be expected. It is impossible to calculate what the result will be till the general formula is approximately known. The formula can only originate from observations more or less skilfully conducted, and must ever be open to modification as knowledge increases. Fortunately, leisure and opportunity have enabled me to produce quite a variety of rigid constructions that have on many occasions soared, and from which I selected the one before you as being most suitable for another experimenter to copy.

Soaring Model.

The soaring kite consists of three parts, the propeller, the weight, and the trail.

It has been found that the propeller is most satisfactorily produced by carving from the solid wood. Inferior articles have been made of tin, aluminium, veneer, and calico.

The curvature and dimensions of this propeller are not supposed to be anywhere near the proportions of what will eventually be the standard, but they give as good results as any I have obtained. The propeller is Lord Kelvin's "Sorting Demon" mentioned in Langley's "Internal work of the wind."

The lead weight consists of 2 hemispheres and a number of discs. These are hung below the propeller in such a manner that adjustments of the quantity and position of the weight in a fore-and-aft direction may be easily made.

Some of the photographs show another method of hanging the weight to the propeller that presents less area for head resistance but has the disadvantage of having no screw adjustment.

The tail acts only as a weather cock. There is no horizontal surface to alter the aspect of the propeller in altitude, this is determined by the position of the weight and its automatic adjustment is still undiscovered.

In order that repeated trial may be made with one of these soaring kites it is absolutely necessary that provision shall be made against breakage. I have used two light poles about 24 feet long standing 48 feet apart on the sand close to the sea, and all the soaring kites I have tried have been hung from the centre of a cord stretched between the pole tops. The hanging line is long enough to prevent the kite striking either the sand or the poles. From this you will see that the kite is free to roam anywhere within a sphere of 40 feet diameter.

The adjustment of the centre of gravity is best made by putting on a slightly excessive amount of ballast, and allowing the kite to swing towards the wind. If the tail lifts, the

weight is too far forward; if the weight is too far aft the kite will seldom pass the plumb position.

It is easier to adjust the amount of ballast for a low than a high angle of soar, because the wind velocity increases with the height; and if the kite gets into the wind for which it is insufficiently loaded, the lead is unable to maintain the propeller at the requisite negative angle.

With a wind velocity of 12 to 14 miles per hour, and a load 1.78 lbs. per square foot, this kite will ascend slowly at an angle of 45° to windward.

With a wind velocity of about 17 miles per hour, and a load of 2.13 lbs. per square foot, it will rise to an angle of 70° or 80° to windward.

Observations of this nature seldom bear immediate fruit, and in the ordinary course of events they must lie buried for an extended period. In the meantime the Aeronautical Society of Great Britain is fulfilling the intentions of its founders, by distributing the seed as widely as possible.

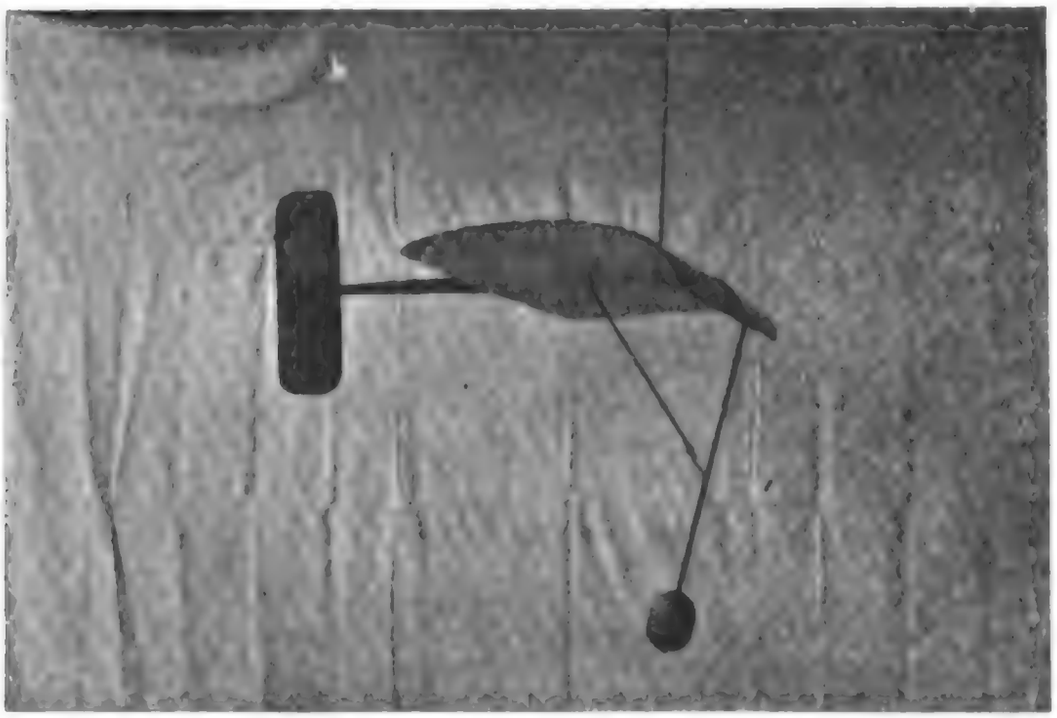
In my papers on soaring, frequent mention is made of a vortex forming in the hollow to leeward of the downward projecting lobe of soaring curves, and that it is this vortex that pushes the wing to windward.

I am now in a position to point to where this vortex can be seen by anyone who wishes.

When a 20-mile breeze is blowing across the top of a steamer's funnel, observe the rolls of smoke pouring out when the furnaces are charged, wait a minute till the smoke thins sufficiently to be almost transparent, and then volumes of smoke of a spherical form will be noticed darting to windward in the centre of the smoke stream from a point about three funnel diameters to leeward; these disappear at the funnel.

Many still speak of this soaring kite as a patent. I have not patented anything and never will. I have not the means or inclination to enter on a campaign with infringers; therefore I rest content with destroying any novelty there may be for ever."

Mr. Hargrave's paper was much applauded. At the close he said that he had a number of photographs and prints, together with copies of papers on the subject which he had brought there for any Member of the Society, or for others, who might wish to forward the objects he had in view. Inspection of the kites would be sufficient to show how they were constructed. They showed the various improvements and methods he had tried and the progress made.



Mr. Hargrave then gave to the Meeting some details of his soaring model, and explained the curve on the under side. The weight, he said, could be adjusted by a screw, and moved backwards and forwards; the weights could also be taken out and replaced by others. He likewise explained his experiments with the machine, which had been conducted on the sea-shore, and as near to the sea as possible, so as to avoid the incline of

the beach; he also gave particulars of the effects of the weight of wind upon his model.

It was only free to go within a sphere of 40 ft. diameter.

The Chairman suggested that, as questions were sure to be asked about it, Mr. Hargrave should take to pieces one of his kites and fold it up, so that the Meeting might see how it was done. Mr. Hargrave willingly complied with this suggestion. He selected what, he said, he considered to be the latest and best of his models, and in the course of a minute or two, with the greatest ease, he had taken it apart and compactly folded it together. To this model there were only four loose pieces.

Mr. Hargrave said that the wood employed was Oregon wood, though he did not know exactly what it was called over here. It was the red-pine, and had turpentine in it.

Mr. Hargrave also folded up one of his other and larger kites.

The best plan for attaching the string was about the back edge of the front sail in a heavy wind, or nearer the middle for light winds. He also showed the Meeting the size and quality of the line used.

The Chairman: Mr. Hargrave has told us of the wonderful soaring feat of this wooden model, but he does not appear, as he said, to account for the "Sorting Demon," as Lord Kelvin called it. I think it would be interesting if Mr. Maxim would give us his ideas of how to account for this wonderful aspiration, or going to the windward—how is it that the machine goes to the windward of its attachment. I know Mr. Maxim has thought very much about it.

Mr. H. Maxim (who was received with applause) said:—"Mr. Chairman, ladies and gentlemen, it was my good fortune during this last Autumn to witness the experiments which were being conducted with Mr. Hargrave's kites at Blue Hill, near Boston, Massachusetts. I should say that that hill is about 500 ft. high, and there is generally a strong wind blowing. They have some very beautiful apparatus for testing the kites there, using steel wire, and I should think they had about three kites on the same line. They told me that on some occasions, when the kites were being pulled down, they would go to the windward, so that they were really on the windward side of the winding station. That, however, did not occur while I was there. I could not catch all Mr. Hargrave said, but if, as I understand it, what he affirms is absolutely true, then the matter is of great importance." Continuing, the speaker gave the result of some experiments as to the proportion of lift to drift, and that on some occasions he had got 18 times as much of the former as of the latter motion. According to Mr. Hargrave's experiments, the quantity of lift in proportion to the drift became infinite. He could not understand it; perhaps Mr. Hargrave could give some explanation of it?

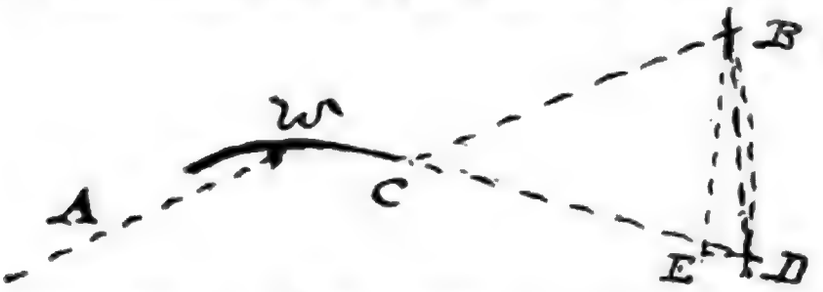
Mr. Hargrave: I am totally unable to explain. I can only speak from my experiments.

Mr. Maxim said that they must understand the weight and load of the kite, and must also compute the angle at which the string was pulling it. As far, however, as actually going against the air was concerned, that was something he was totally unable to comprehend himself. He admitted it was too much for him. (Laughter.)

Mr. Middleton then asked permission to address the meeting, and mounting the platform, explained, more by the use of figures, which he drew in chalk, than by words, how he accounted for the action of Mr. Hargrave's machine. To wit, by calling attention to the fact that as currents of air do not flow generally in straight and horizontal lines, but in more or less wavy curves, *most commonly inclined upwards*, it followed that the explanation of soaring in birds was extremely similar to the mathematical solution of the problem of sailing over the surface of the sea, as the speaker had pointed out in 1890 in his lecture before the Aeronautical Society. And Mr. Middleton added that such mathematical explanation rested on the experimental proof of the *upward* trend of currents of air which was published by Herr Lilienthal in 1889.

That currents or air originally horizontally moving would have impressed on them a vertical component by flowing over highly heated plains or the upward sloping sides of mountains, appeared to the speaker as almost self evident. Still, in physical science it was best if possible to give a proof of the assumed facts on which the validity of such mathematico-physical reasoning rested; and this the speaker repeated he believed was supplied in the matter under discussion by Herr Lilienthal's work. But whether or not Lilienthal was the first to discover the upward trend of these currents of air, one thing was certain, and that was by its admission as a fact the hitherto unexplained, inexplicable or unsolvable problem of soaring became subject to the ordinary laws of mathematical analysis, as would be seen by contemplating the annexed figure or rough diagram, in which the line A represents in direction and magnitude the force with which an elementary current of air impinges on a strip of wing and is deflected without friction or loss of velocity in the direction CD.

For, if we draw from C, the posterior edge of the elementary wing strip, a line CB, parallel and equal in magnitude to the force



produced by the current stream A; and then draw CD of length equal to CB, and tangent to the wing curve at C, it will be seen that the line DB can be looked on as representing the upward reaction of the air against the wing, and the effect thereon would be either progressive and supporting; supporting alone; or retarding and supporting; according to the inclination of this line; or as the point D falls behind; coincides with, or falls before the point E in the vertical line BE. Or in other words according as we turn the deflecting surface of the wing.

Further, Mr. Middleton said he had in past years, spoken to very many people who he believed were competent to reason on these matters, and he thought the points he had put forward could be accepted as a valid explanation of such parts of the observed phenomena as were capable of being rationalized.

However, the explanation given, was not a complete explanation, as it was based on an ignoration of the unknown action of the currents of air impinging on the back of the wing surface. For, it must not be forgotten that the wing was not acted on by the fluid on one side only—as is the case of the vane of a water-wheel—but was wholly immersed in the medium; and most probably the eddies, or vortices,—the "deadwater" so to speak behind the front surface—did have some effect on the resultant action. But in the present state of our knowledge such effect was largely conjectural, and to be deduced by experiment as a percentage of the calculable action on the front surface. Further, there were two experiments—to wit, of Dr. Thomas Young, and Prof. Willis—which seemed to have some bearing on the matter; and even if they did not throw much *light* on the subject, should be mentioned. Mr. Middleton then alluded to Dr. Young's curious discovery that by ejecting a current of air against a bent and suspended metal plate, the latter moved forward to the jet. (This experiment was repeated successfully in 1890 before the A.S.G.B But the printer drew the figure wrongly in the A.S.G.B. report for said year.) However, it was very difficult to say what was the effect of the current on the recurved portion of the plate, or on the part to the right of the supporting string. Possibly, in *the experiment mentioned*, the effect of the vortices disturbing the statical pressures was even greater than the simpler effect caused by fluid impact. But such was a mystery; and Mr. Middleton only mentioned such for Mr. Hargrave's consideration, and not because the speaker himself attributed any preponderating influence to their action; at least in the case of the curved surfaces used in bird flight; where he considered the forward motion in soaring birds, or such as sometimes is seen in flying kites, to be almost entirely produced by the *upward* trend of currents of air whose effects on the wing, or kite, were predicable from our knowledge of the ordinary laws of hydro-mechanics.



Again, later in the evening, and in reply to some objections the Chairman made to Mr. Middleton's remarks on Dr. Young's experiment, Mr. Middleton repeated he had simply mentioned the experiments as being interesting, and as possibly bearing on the matter in hand; but he did *not* think they could hope for any sort of propelling force of sufficient magnitude to help a flying machine forward by means of so-called "aspiration." Indeed everything went to show that the action was too slight to be of any use in aeronautics.

Mr. Archibald then addressed the Meeting. He said: I shall be very pleased to say what I can on the subject. I have had the pleasure of having met Mr. Hargrave in Australia, and saw him flying his own kites in Stanley Park, and I have great pleasure in welcoming him to this country, and in seeing him amongst us. (Applause). I believe that Mr. Hargrave has done as much as any man to advance the whole

Digitized by Google

science of aeronautics, and especially through the medium of his very valuable kites. I have seen his kites flying at Blue Hill, as Mr. Maxim has, and also in conjunction with other kites flying there. They always told me that they trusted Mr. Hargrave's kite when they could not trust the others, and I was quite convinced of that, because most of the others broke up on various occasions. In fact they had a shed there devoted to the pieces of the others. (Laughter). With regard to this question of soaring machines, it seems to me that we shall, in the future, advance more in this direction than in any other. In the first place, the great point seems to be the curve, which imitates the curve of the bird's wing, and it must be admitted that birds accomplish things which we cannot do—there is no doubt about that. The Creator designed them in some way to do things which we cannot even work out by our equations. On looking at the matter, it seems to me that we might resolve this question into a simpler form if we regarded the back part of the curve as the part that does the lifting, and the front part, if there is any pressure of air there, must tend to send it forward. In that way the combination of the two surfaces might produce the effect. Of course this is only a hint on my part. If the matter were referred to some of our most profound mathematicians, it might be an advantage because it would show what was possible. The facts which Mr. Hargrave can verify show that something is done which we cannot account for. Something is done of which we cannot get the full explanation, but that does not take away from the fact that it is there, and I do not see any practical reason why it should not be developed into a means of using it as a flying-machine accessary. I regard the whole of this as preliminary, so far as flying is concerned. A flying-machine must have power behind it to drive it forward: therefore, we must have an engine of some description. I understand that Mr. Hargrave intended to fly his machine before the end of the century, but I am afraid we shall have to wait a little longer before that is accomplished. At the same time, I am one of those who believe it will be done, and I am sure, with Mr. Maxim and Mr. Hargrave working at it, that we ought to accomplish it in time. I do not know that I have anything further to say, except that the kite here is a little different to the one I remember seeing on a former occasion, and I suppose that the curved surfaces are a new feature in it. It seems to me that this curved surface is one of the elements which will probably lead to more than the flat surface. It is the development of the curves which has led to such remarkable results. I should like to see one of those new kites flying vertically. When I flew my kites in 1884 I thought it good enough if I got an angle of 36 degrees. Theoretically, according to Marvin, the angle of a plane kite seems to be about 60, though perhaps Captain Baden-Powell will tell me that he has got to a higher angle with his plane kite. With the curved kite it seems possible to get verticality. If this proves to be the case, we shall then be able to send up our instruments, with very much less rope than at present. Perhaps Mr. Hargrave will give us his opinion as to this. I hope he will go on with his experiments, and and I am sure we are all very well pleased to have him here in our midst. I hope he will not go back to Australia before he has made further improvements in his machine, and shown us what it can do. (Applause.)

The Chairman said he did not wish Mr. Hargrave to leave them that night without having made it clear to all present what had been the main points he had brought out in the experiments.

Mr. Hargrave, by the aid of figures which he drew, then explained to the Meeting how his experiments had been carried out on the sea-shore. Also the effects of light and heavy winds on the direction taken by the model.

Mr. Maxim again addressed the Meeting, giving them some illustrations from his paper on "How Birds Soar." He had seen eagles in Spain who, with their wings perfectly rigid, had gone completely across the plain, without a movement of their wings. They all knew how sea-gulls rested, as it were, on the air. He had seen eagles in the Pyrenees which with extended wings had balanced themselves on the ascending breeze. He said that most of the audience had, at some time, noticed how gulls followed a ship. Those birds were easy enough in a certain position, but the moment they got out of that position they had to work with their wings. As a matter of fact, they were falling as related to the wind. Every body that they saw soaring in the air was really falling so far as related to the air. He also mentioned the glassy streaks seen in the Mediterranean Sea and elsewhere, which he submitted were perhaps in part due to the currents of air meeting and ascending and coming down again at a distance. Some birds had most sensitive wings: they could feel the exact pressure and direction of the air, and were able to choose and keep their position with a nicety. The direction of the wind was also due to the earth's formation.

Digitized by Google

The wind generally moved parallel with the surface over which he blew. Mr. Maxim also told the story of a sailing ship at Erith. It was always found handy to have a tug to tow the ship into port, so the engines of the tug were put into the ship, when it was thought that they would have the same power over the ship as when they were in the tug, but which ever way the engines turned, the ship would back. (Laughter.) Mr. Maxim also described the experiments he had made with the screw propeller. He had made a propeller that would back no matter which way it was run. As he had said before, the air was constantly changing, and birds were able to soar as they did by taking advantage of ascending currents.

The Chairman said that Mr. Hargrave had told them the conditions under which he obtained what he believed to be evidence of this wooden model aspiring or going to windward, and he thought Mr. Hargrave put the fact down to some such phenomena as Mr. Maxim had described, to some alternations and twistings of the wind, of which the machine was able to take advantage.

Mr. Hargrave said that no one believed now that the wind blew straight, and the machine doubtless took advantage of the currents. An up-trend in the wind would account for anything. He then read a short extract from a paper as to the soaring wing of a bird.

The Chairman said that he could not agree with what Mr. Middleton had told them about the bent metal plate moving to windward against a forced blast of air. His explanation seemed to imply perpetual motion, or the getting power out of nothing. He thought that aspiration from such an action as Mr. Middleton had described was impossible.

Captain Baden-Powell (who was cordially received) said: As a great deal has been said about the ascending currents of air, I may perhaps be allowed to say a word or two about the experiments which I have made with kites which certainly impressed me with the fact that there are nearly always ascending currents if there is any wind blowing. There is one experiment I made that almost alarmed me. I was flying one of my kites which had got to a very high angle, and it steadily rose until it got absolutely over head, and the string was hanging perpendicularly. I thought that this was an extraordinary result, so I took up a heavy piece of wood, and I tied it to the string, and it steadily rose. I thought I had come across some marvellous discovery, and I should think it remained suspended for perhaps twenty seconds, hovering in mid air without any connection with the ground, and then the kite began to drift off to leeward, and the wood came to the ground, and I then arrived at the conclusion that this was solely owing to the wind taking temporarily a strong up-turn. We were also speaking of the kites at Blue Hill rising to a very high angle when being pulled down. I have continually found with kites that, if you draw in the string very rapidly, they will pass absolutely overhead, in fact, I could always, if I wanted, by drawing in my kite rapidly, work it up to windward, so that it fell to the ground to the windward of where the string was being held. I have shown my kites once or twice to the members, so that they all know their form. They are very different from the carefully constructed models we see here. Mine are certainly not so scientifically constructed, though they may be more easy to handle or to fold up or open. I have not had the advantage of flying any of these carefully-made kites, and so I should not like to say that mine are in any way better. I think that we all thoroughly appreciate Mr. Hargrave's visit here to-night. (Applause.) We know that he has not only experimented in those kites which we see before us, and in this very interesting soaring model which we really can none of us understand, but we know also that he has made a great number of experiments in other directions. We know that he has made several most interesting models of engines, I think in steam, oil, compressed air and other varieties. I am sure, therefore, that whether Mr. Hargrave is successful or not in producing a flying-machine, at any rate, his name will be always remembered in connection with the subject. (Applause.)

Mr. Davidson asked: What is the practical value of the discussion this evening. We want something practical—are we getting it?

The Chairman: The subject of the discussion is really more than anything, this. Mr. Hargrave has shown us his kites, and has given us evidence to believe that aspiration is possible under certain circumstances, and we want to come to the conclusion whether it is, or whether it is not practical.

Mr. Davidson: Whether it is, or is not, whether there is an upward tend or whether there is not, if we are going to have a practical machine we ought not to rely upon the uncertainty of these upward tends in the air. If we have to rely upon these, what is the value of the machine. We cannot always get them. Mr. Maxim has pointed out that a bird is easy in one position but not in another, and has to choose its position—we cannot do that. If we are going to make any machine that is really going to travel through the air, we must

Digitized by Google

not rely upon these things, and it seems to me to be entirely beyond the question to go into, and endeavour to find out about them.

Mr. Maxim said he thought they might compare soaring birds to the old sailing ships with two sails. They did not travel by those at the present time, they used steamships. There were several classes of birds which he might compare to a steamship or a locomotive, where a vast amount of energy was expended. The birds that followed a ship probably did not exert any power at all. Geese, ducks, partridges and similar birds did not take the wind into consideration at all: they simply forged ahead, independent of which way the wind was blowing, at the expense of a large amount of power. These exerted sufficient power to be independent of the wind—that was what we must do. Then came the question of getting machines of the right shape and form. He had spent £20,000 in that direction, and now a further sum was wanted, and he was saving up—walking instead of taking cabs, etc. to save—(Laughter)—another £20,000. He did not expect they would succeed all at once; he thought it was a matter of time.

Mr. Alfred Walker said that aspiration was spoken of in two senses, a Frenchman (Mouillard) had published a book giving his observations of the soaring of vultures in Egypt, and expressing the hope of Manflying in still air without expenditure of energy. To those of us who believe in the conservation of energy, aspiration in this sense is impossible; but if by aspiration we mean flying in a wind without expenditure of energy, this might be possible by getting energy from the eddies in the wind. The wave boat invented some years since by Mr. Hargrave is a case of aspiration in water. With respect to the motion of the S shaped surface, it seemed to be akin to the motion of the ball which goes towards the jet in a ball hydrant, and they could not hope for anything from that because the jet would have to be moved as the ball moved. He had experimented with a somewhat similar model to the one in question, which he had tied to a fishing rod. He had a small horizontal surface for the tail, and when he had tried to do without that horizontal surface, the machine had a great tendency to duck down at the front. He should like to ask Mr. Hargrave whether he had tried this model as a kite, and whether there was any similar tendency to duck down at the front. He also made other enquires as to Mr. Hargrave's experiments. Mr. Maxim had given them the result of his very interesting observations, and had explained soaring on the theory of an upward current; this, no doubt, applied to many cases of soaring, but not to all, perhaps not to the case of the albatross. Lilienthal had spoken of a wind blowing over level ground with an average tendency upwards of 3°, this would appear impossible as it would at once result in a vacuum at the surface of the ground. The most important point to be noted in flying a kite is the angle of the string, or how near the zenith will the kite remain in steady flight over level ground, neither his (Mr. Walker's) own experiments, nor any records he had seen showed this to be less than 30° away from the zenith in the case of box kites, and until a far better angle than this is attained we canot hope to fly.

Dr. Biddle thought that not quite enough had been made of the law of action and reaction. Being curved downward at the back, as the horizontal wind came, it deflected the plane of wind upwards, and the reaction tended to have a forward effect. They had more of the surface curved at the back than in front; the consequence was that the tendency would be to go forward as it rose, being pressed by the resistance of air to its rising. At any rate, that might have some influence. His theory of the matter was based to a large extent on the well-known laws of action and reaction.

Captain Baden-Powell said that, in reference to the remarks made by Mr. Walker as to the curved model being flown as a kite, he had made just such a model some years ago and tried it, and had had the same results—that it would always duck forward. As to what the speaker had said about kites flying at no better angle than thirty, he might say that although the angles of the strings of his kites had varied a great deal, according to the weather and other circumstances, yet he could always get an angle of at least forty-five.

Mr. Walker explained that he meant thirty degrees from the vertical.

Mr. Reid said that doubtless many members would like to try experiments with the Hargrave kites, and would be glad to learn where they were procurable.

The Chairman: I think I had better state at once that Mr. Hargrave has most kindly given the whole of the kites to Captain Baden-Powell, and he, in turn, has made them a present to the Society, and they will be available some day or other, for anybody to come and look at and measure up—I believe even to practise with. (Applause.)

Mr. Reid asked if Mr. Hargrave had tried celluloid in his inventions. With regard to

Digitized by Google

ascending currents, he thought that the spot chosen by Mr. Hargrave—the sea-shore—was precisely the spot where an ascending current would be found, but you could not have ascending currents everywhere. He should like to ask whether Mr. Hargrave took the directions of the air.

Mr. Hare said he should like to ask Mr. Hargrave whether he had tried the effect of suspending his curved kite, not by one string from the middle, but by a string fore and aft.

Mr. Hargrave in answering the questions which had been put said that he thought it best to pass over any remarks that had been made about an ascending tend in the wind, because in an ascending current, almost anything could be done. With regard to the angle at which a kite could float, if they hauled any kite down, it would come down at a zenith. He believed that was common to any kite. He said he had never flown one of his wood model machines with string, as an ordinary kite. He had never used celluloid himself for his machine. He had used vulcanite, but had not found it good; it buckled and twisted, and was not so stiff as wood.

The Chairman: I think we have all to thank Mr. Hargrave very much for his most interesting paper which he had given them under the auspices of the Society. He was sure they would fully appreciate the great trouble he had taken in bringing all those beautiful kites to show them. (Applause.)

He thought everybody would admire the beauty and the details of design of the kites. Big kites were generally such exceedingly clumsy things: they wou'd not fold up, and needed several men to handle them, whereas Mr. Hargrave's kites could easily be managed single handed. Mr. Hargrave has remarked that he has sown seeds which he does not expect will bear any immediate fruit, but let us hope that Mr. Hargrave's seeds will not lie dormant, but let us try as a body, backed by Captain Baden-Powell's great energy to do our best to let these seeds bear immediate fruit. (Cheers.) I think the best thing that can be done, since Mr. Hargrave has given this collection of kites to the Society, will be for the Society to try and subscribe enough funds to found a club-house somewhere out of London at which experiments can be made, and where the Society can store any flying apparatus (which is occasionally rather a white elephant) or anything else that may be made, and where members can go and try experiments with the models and things which others have made. I believe you will hear further from the Secretary as to this. I just wish to say that Dr. Barton was to have read a paper to-night on "Navigable Balloons," but he has consented to postpone his paper to another time, as it is now so late. When we have passed a vote of thanks to Mr. Hargrave, Dr. Biddle will explain the piece of apparatus that he has brought with him as to the steering of balloons. You will remember what was said on this subject in the last number of the Aeronautical Journal. I now call upon the Meeting for a vote of thanks to Mr. Hargrave.

Everybody present heartily responded to the Chairman's request, and gave Mr. Hargrave a most enthusiastic ovation.

In acknowledging the vote, Mr. Hargrave said that his task had been a labour of love. He felt he knew a few things concerning the matter, and he hoped to forage out more.

Dr. Biddle's Apparatus.

Dr. Biddle then gave a short description of his balloon-steering apparatus* to the Meeting, saying that he had brought the sail to show to them at the suggestion of Captain Baden-Powell. The idea was exceedingly simple: it had been mooted years ago by a Frenchman, but had not been carried out in the same manner, as he had sails acting on the same principle attached to the bag of the balloon, whereas his (Dr. Biddle's) apparatus was intended to be placed between the car and the bag. This he contended was the best position. Dr. Biddle also explained the rudder, which, he said, was constructed on much the same principle as the mainsail. The apparatus was only effective during the ascent and descent of the balloon. It was dependent for its action upon the resistance of the air. The contrivance had been exhibited to the Balloon Committee of the War Office 25 years ago, and he had also read a paper on the subject (which paper had been reprinted) to a meeting of the Balloon Society of Great Britain. It had also been exhibited at the Royal Aquarium. The War Office were not satisfied with anything that did not enable them to steer a balloon horizontally. He (Dr. Biddle) would have liked to have exhibited to that Meeting, could he have done so with safety, the apparatus as applied to a balloon. (Applause.)

* Described in the last (April) number of the "Aeronautical Journal."

Digitized by Google

On Flapping Flight of Aeroplanes.

By Maurice F. Fitz-Gerald, Professor of Engineering, Queen's College, Belfast.

[From the Proceedings of the Royal Society.]

It has been long known, principally through experiments on soaring, that a large, if not by far the largest, part of the supporting force obtained by birds in regular flight, is probably furnished by upward air pressure on their wings, regarded as planes moving horizontally, with their surfaces slightly inclined to the direction of motion.

Langley's "Experiments on Aero-dynamics" furnish some numerical data for estimating the power required to sustain an aeroplane of given weight, propelled horizontally by a known force, and he applies these to the determination of the problem whether this could be effected by screw propellers, analogous to those of a ship, actuated by machinery of existing type.

The older mathematical investigation by Navier of the problem of flapping flight, seems to be quite discredited, and, indeed, the results brought out always laboured under the physiological difficulty of demanding an amount of horse power per pound of muscle in birds which surpassed, to an almost incredible extent, that available from the better known muscular tissues of other animals. One horse power is 550 ft.-lbs. per second; a horse can ordinarily exert about two-thirds of this, and if we take him to weigh about 10 cwt., we get about a third of a ft.-lb. per second per pound of horse. A man can work at the rate of about 50 ft.-lbs. per second; this, again, is about a third of a ft.-lb. per second per pound of man; and so on with other animals. But, for the flight of birds, it was made out that from about 30 to 1300 ft.-lbs. per second per pound of bird were necessary, which, even after all allowance for higher temperature of their bodies, and large relative mass of wing muscles, compared with those of the limbs of horses, men, &c., seemed highly improbable.

In the following paper an attempt is made to indicate how both progressive and hovering flight may be effected by aeroplanes, attached to a heavy mass, and flapped after the manner of wings, under conditions sufficiently nearly approaching those of Langley's experiments to justify the inference, from his figures, of numerical results, not indeed presumably exact, but sufficiently indicating the order of magnitude of the quantities involved. The figures given may be taken, commercially speaking, as near enough to the truth to enable us to judge whether we are dealing with pounds or with pence, though not exact enough to adjust the change out of half-a-crown in paying for our power.

Let, then, a heavy mass be supposed to be flying through the air horizontally, and be supported by wings, consisting of planes of negligible mass, held nearly edgewise to the direction of motion, and moved vertically up and down by some machinery carried by the heavy mass. Let there be in addition some arrangement of the machinery by which the angle of inclination of the planes of wings to their direction of motion is variable. We shall suppose the velocity of progression high, and variations of the propelling force small enough for changes of forward velocity to be neglected, compared to the average forward velocity. This is justified by Langley's experiments, which show that, for small inclinations of an aeroplane, the direct resistance to forward motion is small compared to the supporting force. We shall also, in the first instance, neglect direct air resistance on the heavy mass as small compared with that on the aeroplanes; and, for convenience, we shall call the heavy mass the bird's body and the attached aeroplane the wings.

The case differs from that of a real bird most notably by the circumstances that the aeroplane in our theoretical case has no mass, whereas, a bird's wings have one of very sensible magnitude compared with that of its body, and the aeroplane is supposed to be moved up and down, relatively to the mass, as a whole, instead of being pivoted to it, as a birds wings are to its body, besides being of constant area, which wings are not. Consequently, as before remarked, numerical results can only be regarded as indicating the order of magnitude of the quantities calculated, not their exact values.

The inclination of the wings being variable, and their motion being compounded of an up-and-down one with a forward one, it is evident that the supporting force may be periodically variable also, and consequently the bird's body will move in a sinuous or wavy path, on the whole horizontal, and the stroke of the wings will be the relative motion of wings and body. If the horizontal velocity be high, and the amplitude of the wing stroke relatively to the air moderate, and the variations

in the supporting force not too great, the path of the bird's body will be only slightly waved so that fig. 1 may be taken as, in a general sort of way, representing what takes place.

In the same figure A_1B_1, A_2B_2, &c., represent the plane of the wing at different successive positions, seen edgewise, and P_1, P_2, &c., the corresponding resultant air pressures on it, in direction and magnitude. Now it is plainly a matter of arrangement of mechanism what these shall be, as they depend on the angle between the lines A_1B_1, &c., and the tangent to the heavy line, marked "Path of wing" at each instant. Consequently it is worth while inquiring what are the conditions of adjustment to cause a forward force on an average to be applied to the bird and wings, when the wings are moved up and down by an engine forming part of the bird's body, when the supporting force is, on an average, equal to the bird's weight, and the forward force is, on an average, equal to that required, on an average, to propel the aeroplane at its average inclination. Observe that the force P_α depends for its magnitude, not on the actual inclination of the wing path at all, but on the angle between that path and the plane of the wing, while its horizontal component depends on both angles, so that although, as long as there is any supporting force, there is a resistance to forward motion along the wing path, there may nevertheless be a forward force acting horizontally on the whole machine, wings and body taken together, as in the first position shown, for instance.

The thing to do, then, is to formulate this in symbols, and for the present purpose it will suffice to make some simplifying approximations to facilitate the work. We shall then take it that the inclination of the wing path to the horizontal, and the inclination of the plane of the wing to the wing path, are both small enough to assume that for either of them, as well as their sum, the circular measure, the sine, and the tangent do not sensibly differ, and the cosine is unity, for example, for 20° circular measure = 0·349, sine = 0·342, tangent = 0·363, and cosine = 0·94; so that up to this at any rate, we shall not be incurring errors exceeding 5 or 6 per cent. by this assumption.

We shall also assume that for a small angle (α) of inclination of an aeroplane to its path, the resultant air pressure is given by the formula $P\alpha = 2kV^2 \sin \alpha$ in pounds per square foot, where V is velocity in feet per second, and k a coefficient, which, according to Langley, is about 0·0017, and $P\alpha$ is directed normally to the plane. This agrees nearly with Du Chemins's formula at small angles, as pointed out by Langley.

Now let the angle α be varied according to the law

$$\alpha = m(1 - \mu \cos pt),$$

m and μ being arbitrary constants, p being $2\pi f$ where f is the frequency or number of flaps per second, t being time in seconds.

Then the normal pressure, $P\alpha$, on a plane of area A, at forward velocity V, inclined at α to its direction of motion is

$$P\alpha = 2kV^2Am(1 - \mu \cos pt).$$

For convenience we shall take the bird's weight as 1 lb., so that, in general, $P\alpha$ will be for any other weight, normal pressure in lbs. per lb. of bird, and A is wing area in square feet per lb. of bird.

Let, at any moment, Z be the height above some datum level of the bird's centre of gravity, and z that of centre of pressure of wings and suppose that

$$z = S \sin (pt + \theta).$$

Then the slope, s, of the wing path is at any moment sensibly

$$s = \frac{pS}{V}(pt + \theta)$$

supposed to be always a small angle.

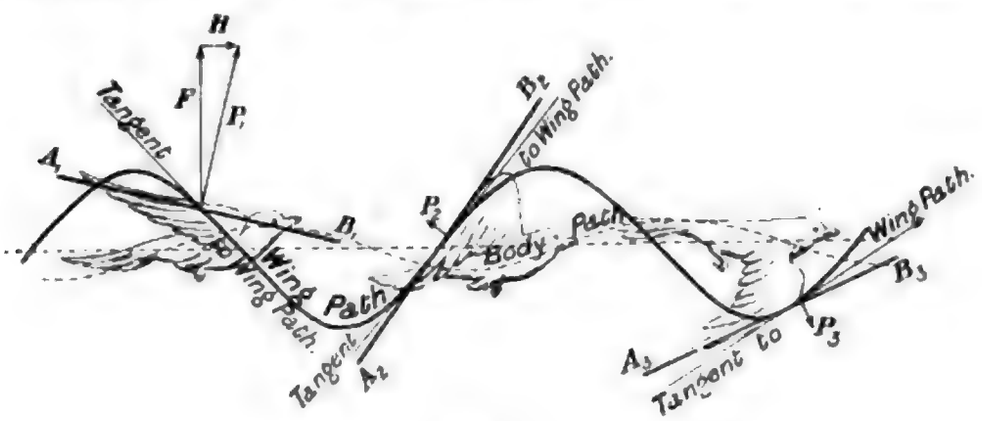


Fig 1.

Digitized by Google

By fig. 1 we see that if F be the vertical supporting force,

$$F = Pa \cos(s + a) = Pa \text{ sensibly,}$$

since $(s + a)$ is supposed a small angle; and if H be the horizontal component of Pa,

$$H = -Pa \sin(s + a)$$
$$= -Pa(s + a) \text{ nearly.}$$

This is the resistance to forward motion horizontally, and the work done against it, taking the average rate of working, is

$$U = \frac{p}{2\pi}\int_0^{2\pi/p} VPa(s + a)dt \text{ ft.-lbs. per second.}$$

Again, if the bird's body be rising at the rate dZ/dt, and the wings at a lesser rate, dz/dt, the engine attached to the body, which exerts a downward force, F, on the wings, is doing work, so that, when F is positive, and $\frac{d}{dt}(Z - z)$ positive, the engine does work, and this is to be the same work, on the average, as that done to overcome the resistance of the air to the plane taken along its actual path, and is

$$W = \frac{p}{2\pi}\int_0^{2\pi/p} Pa\frac{d}{dt}(Z - z)dt.$$

Consequently we get, as a condition for determining some relations among the constants,

$$\int_0^{2\pi/p} VP_a a ds = \int_0^{2\pi/p} Pa\frac{d}{dt}(Z - z)dt \ldots\ldots\ldots\ldots(A)$$

Another condition arises as follows. As F, the vertical force, is sensibly equal to Pa, we have, for the motion of the bird's body,

$\frac{d^2Z}{dt^2} = g(Pa - 1)$, the bird being 1 lb. weight,

$$= g\left\{2kAV^2m(1 - \mu\cos pt) - 1\right\}$$

and, on integration, all terms containing t^2 or t as factors must vanish, in order for the motion to be, on an average, horizontal. That containing t^2 as a factor will not vanish unless

$$2kAV^2m = 1 \text{ which fixes } m, \ldots\ldots\ldots (B)$$

and gives $\frac{dZ}{dt} = -\frac{\mu g}{p}\sin pt$ as there is no term with t as factor in Z.

By differentiation

$$\frac{dz}{dt} = pS\cos(pt + \theta),$$

whence

$$\frac{d}{dt}(Z - z) = -\left\{\frac{\mu g}{p}\sin pt + pS\cos(pt + \theta)\right\}$$

Inserting their values in (A) for the quantities involved, we get

$$\int_0^{2\pi/p} \frac{V}{2kAV^2}(1 - \mu\cos pt)^2 dt = -\int_0^{2\pi/p} (1 - \mu\cos pt)\left[\frac{\mu g}{p}\sin pt + pS\cos(pt + \theta)\right] dt$$

On integration, the only terms that do not vanish give the equation

$$\frac{1}{2kAV} + \tfrac{1}{2}\cdot\frac{\mu^2}{2kAV} = \tfrac{1}{2}\mu pS\cos\theta,$$

which is quadratic for μ, namely,

$$\mu^2 - 2kAVpS\cos\theta\mu + 2 = 0 \ldots\ldots\ldots(C)$$

Taking the integral of one side alone we find

$$W = \frac{\mu pS\cos\theta}{2} \ldots\ldots\ldots\ldots(D)$$

Eliminating μ from these we get

$$pS\cos\theta = +\frac{W}{\sqrt{(kAVW - \tfrac{1}{2})}} \ldots\ldots\ldots\ldots(E)$$

If now we draw a curve whose ordinate, y, is $pS\cos\theta$, and abscissa, x, is W, we find it to be of the form shown as AB or CD in fig. 1, with a symmetrical branch below the axis of x, not shown in the figure. On account of the steepness of the first part of the curve CD, that part of it which extends from W = 2·5 to W = 3 is shown with the scale of abscissæ magnified fifty times, as AB, and corresponding curves for μ are given. The case taken is when AV = 120, so that it applies to flight at 60 feet per second, if the wing area is 2 square feet per pound carried, 30 feet per second with an allowance of 4 square feet per pound, and so on.

The principal things to note about the curves are that, in the first place, W has a minimum value, in this case 2·5 ft.-lbs. per second per pound carried. This occurs when $pS\cos\theta$ is infinite, and practically implies that when the rate of flapping is very high, keeping the same stroke, the horse-power required comes very near the minimum, and, remarkably enough, the wing becomes, virtually, exactly equivalent to a plane of area A, inclined at a constant angle $a = m$, moving horizontally, as in Langley's experiments. This is not accidental, but seems to follow from the circumstance that $2W = \mu pS\cos\theta$, and if $pS\cos\theta$ be infinite and W finite, μ must vanish, and, consequently, $= m(1 - \mu\cos\theta)$ becomes $a = m$ simply.

[*Note added March* 21, 1899.—In the paper as read an erroneous statement here followed, to the effect that the minimum value of W was half that got in Langley's experiments with a plane at angle $a = m$. It arose from the left-hand side in equation (A) being, by mistake, written $\int_0^{2\pi/p} VPa(s + a)dt$, instead of as given above. The author is indebted to Prof. J. Purser for pointing out the mistake. The least value of W is equal to that of Langley's experiments.]

Of course, as before mentioned, it is not to be taken that the figure 2·65 ft.-lbs. per second

Digitized by

per pound of bird, is here demonstrated to be that which a real bird, with 2 square feet of wing per lb. of bird, flying at 60 feet per second, would or must exert. All that is professed to be shown is, that the bird may be able to fly with the exertion of two or three ft.-lbs. per second per pound, and that 30 to 1300 are quite unnecessary. Further, it appears that, within a very large range of the values of pS cos θ, that is frequency of flapping, stroke, and lag of phase of stroke relatively to phase of bird's body motion and twisting of wing, there may be little comparative variation in the horse-power—*e.g.*, between frequency per minute 500 and frequency 250 (supposing S cos $\theta = 1$), there would only be a change of work per second from 2·51 to 2·55—scarcely 2 per cent.

This seems to bear on the explanation of the great range of variation in the manner of birds' use of their wings; some (as pigeons and ducks) flapping very fast, others (as seagulls and herons) flapping but slowly, without any physiological reason for expecting material differences in the rate at which their muscles can give out energy. There are, no doubt, plenty of other reasons, but until experiments can be made on planes or other surfaces flapped by pivoting on an axis, numerical data for conditions of calculation agreeing more nearly than those here used with conditions of fact, seem to be wanting.

Another point brought out is that pS cos θ has a minimum value as well as W, but μ has not. This means that the phase of the wing motion, relatively to the twisting of the wing (on which the angle α depends) is important, and if these are out of beat, so to speak, by

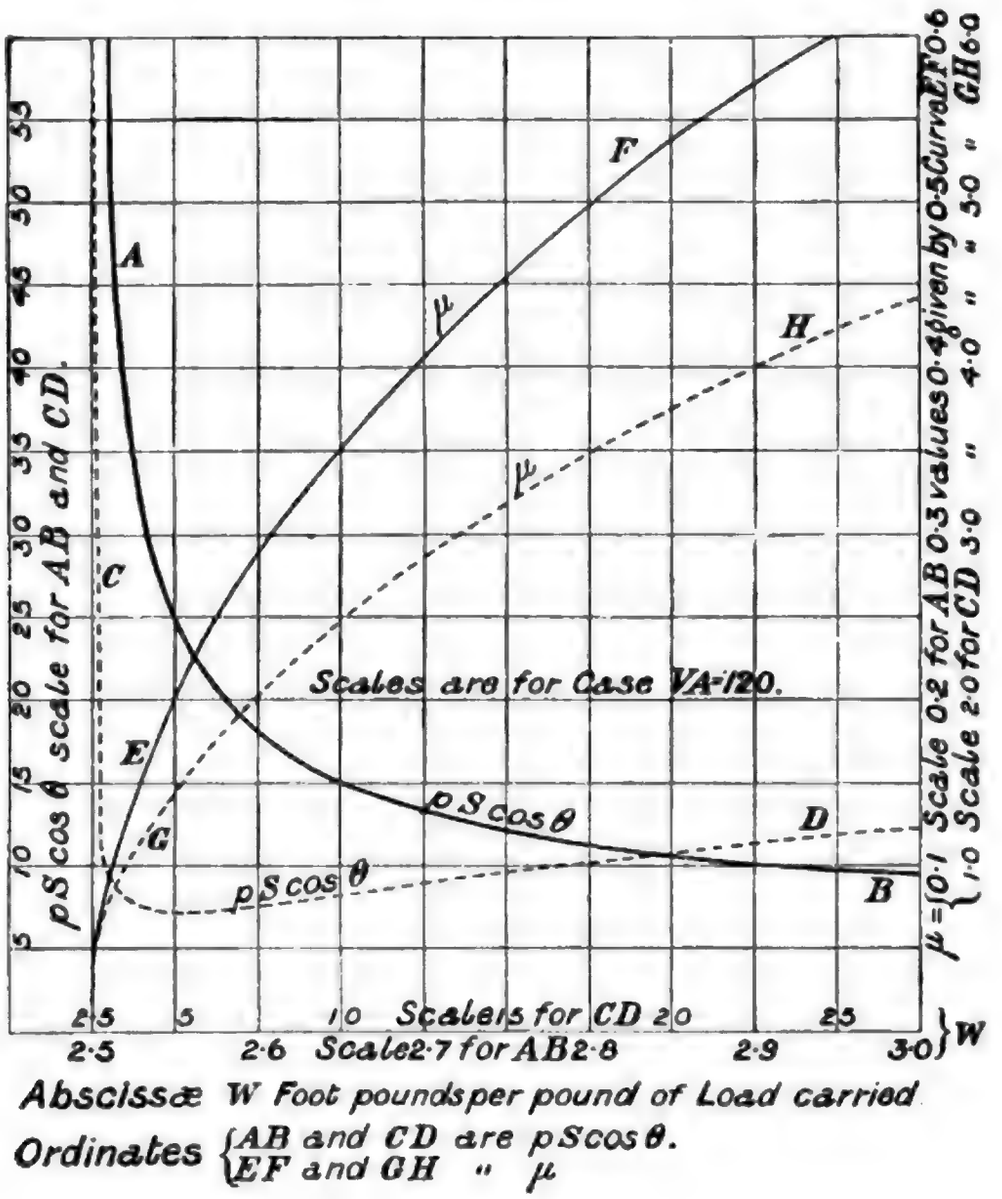


Fig. 2.

Digitized by Google

more than a certain amount, with a given frequency and stroke. the flight cannot be maintained at all. The values of μ which exceed unity imply (on reference to the equation $a = m\ (1 - \mu \cos pt)$) that there is a reversed pressure on the wing during part of the stroke, as shown in fig. 1 at the third position, where P_3 is directed partly downwards. This condition is however unfavourable, probably in all cases, to economy of labour, though it may be favourable to forward propulsion. At all economical rates of working μ is quite small, that is, the inclination of wing plane to wing path varies but little.

It may also be observed that, for any value of pS cos θ, there are two of W, one of which lies close to its least possible value, and the other is very large—*e.g.*, for pS cos $\theta = 15$, W = 2·65 or about 40, so that a person who was going on observed values of pS and took cos θ to be nearly unity, might easily overlook the small value of W, and base his estimate of work on the large one. This is the more likely as the curve of pS cos θ is of the third degree, and the solving of a cubic by a direct process, especially when there are three real roots, is troublesome, and avoided in consequence. Whether anything of this kind occurred in Navier's or other earlier investigations, the present writer is unable to say. Langley says that Navier added the work done, here expressed by the right-hand side of equation (A) to that on the other to find the whole. Why it should have seemed necessary to do this is not clear, for if the wing has no sensible mass, as here assumed, the pressure of the engine downwards cannot exceed F, and no work can be done by a vertically moving engine, except that expressed on the right-hand side of equation (A). The way in which forward motion is maintained bears some analogy to the process of so-called "invisible" skating, and to screw propulsion, wherein it would be manifestly absurd to add the work done against the ship's resistance to that given by the turning moment applied to the screw, to find the horse-power of the engine. In fact, the construction of Langley's whirling table virtually made the aeroplane a portion of a screw propeller with axis vertical, and his coefficient k has, bound up in it, the inefficiency of the propeller in converting horse-power of turning couple into thrust.

With regard to the absolute magnitude of the figure 2·5 as the least value possible for W in the case illustrated by fig. 2, it is of importance to note that this depends on m, and m has been made $= \frac{1}{2k}AV^2$ on the strength of the equation

$$\frac{d^2Z}{dt} - g(P\alpha - 1) = g\left\{2k\mathrm{AV}^2 m(1 - \mu \cos pt) - 1\right\}$$

which again depends on the assumption that the downward acceleration of the body attached to the aeroplane would be g, irrespective of the horizontal velocity of the plane, if the angle of inclination of the plane to its path were zero. Langley's experiments on the "Plane Dropper" seem to show that this is by no means the case, but, unfortunately, he was unable, through uncontrollable circumstances, to determine the proper value, which is some function of the velocity, and may possibly be so small as $g/3$ at his highest velocities. If so mV which is the minimum value of W requires corresponding reduction, and. in the case taken, the scale of W is about three times too large, reducing the necessary work to about 1 ft.-lb. per pound carried or thereabouts. It is now evident how the energy expenditure of birds may lie within quite reasonable limits, though we cannot, with any approach to accuracy, make the calculations for the design of a flying machine with flapping wings. We can say it will not in a given case cost a pound an hour for power, but we cannot tell whether it will cost only sixpence, or as much as half-a-crown or three shillings.

To allow for head resistance of the bird's body some term must be added to the left-hand side of equation (A), which will alter the absolute term of equation (C) and the ½ under the square root in equation (E) so as to increase W, and a number of small corrections of other kinds might be made, which, however, considering the roughness of the numerical data we have to go upon, are not worth taking into account.

The justification of the assumption as to the smallness of a and s is best exhibited by a numerical example. Taking then AV = 120 with A = 2 square feet per pound of bird, and assuming S = 0·5 (a stroke of 1 foot) we find that if p = 30 (about 300 downward strokes per minute, which sea-gulls in regular flight often exceed) and cos θ = 1, Sp cos θ = 15, and W = 2·65; while μ is 0·35, and m is 0·041. The maximum value of a is then 0·041(1 + 0·35) when $pt = \pi$. This is 0·0554, the circular measure of 3° 10′ nearly. The maximum value of s, the slope of wing path, is pS/V = 0·25; the circular measure of 14° 20′; but these do not occur simultaneously.

It will be found that their sum is a maximum when pt = 0 and is then 0·28, the circular measure of 16°; thus lying well below the limit

Digitized by Google

of 20° suggested in the earlier part of this paper. The body path on integration, and taking $Z = 0$ and $dZ/dt = 0$ initially, is $Z = -\mu g/p^2 (1 - \cos pt)$ and the amplitude is 0·0125 foot. The body, therefore, pursues a simple harmonic path, whose average is about 5/32 inch below the mean level of the wing path, and whose total rise and fall from crest to hollow is almost 5/16 inch. The relative motion of wing and body does not sensibly differ from that of the wing alone.

The investigation of the question as to hovering is far less satisfactory. We might assume, for instance, that the centre of pressure of the wings followed a circular or elliptical orbit, the plane of the wings making a small angle with the tangent to the orbit, and being variable as before, so as to maintain, on the whole, an upward pressure. If we make this angle $\alpha = m \sin pt$, and form the equation $d^2Z/dt^2 = g(F - 1)$ as before, remembering, however, that though α may be assumed small, the angle of slope, s, of the wing path, is not, we shall find, if the orbit be taken to be circular, $m = 1/kV^2$ where V is the velocity of the motion along the orbit. In order that m may have values similar to those in the case of progressive flight, the frequency of flapping must be much higher, twice as fast, or thereabouts. But there are several considerations which render results of this kind much more unsatisfactory than those previously obtained. In the first place the motion assumed is very much less like that of a bird's wing than in the former case, inasmuch as it involves complete revolution of the plane of the wing about a horizontal axis in its own plane, and, in the second place, the edges of the plane are continually cutting across the eddies, created by their previous motion, in a very different way from that in which they interfere with those created in progressive flight, so that the numerical value of k, and the value of the function of V which is put down as 1 in the formula $d^2Z/dt^2 = g(F - 1)$ are really unknown, and cannot be inferred from experiments with soaring planes, or even propellers. We can only expect that the actual numbers will be tolerably like those given by Langley's and other such experiments.

All that can be inferred, therefore, is that, provided a sufficiently high speed of flapping is attainable, we may reasonably anticipate that the horse-power for hovering need not differ very materially from that for progressive flight. Internal stresses in the wings or machinery due to their inertia, as well as physiological difficulties connected with high velocities of reciprocation, may also come in to limit the rate of flapping, and prevent an equally economical rate of working being attainable in hovering, as in progressive flight. A considerable simplification of the mere mathematics could have been effected by at once assuming that the arrangement for altering the angle α was so contrived as to make the pressure $P\alpha$, or its vertical component F, an assigned function of the time; but this has the objection that, there being then no expressly formulated relation between α and P or F, experimental evidence would be wanting to settle the values of the numerical constants involved. In fact, the more the mathematical work is generalized, the less definite do the numerical results become, in the present state of our experimental knowledge, and this must form the writer's apology for working out, in a mathematically clumsy way, so limited a case of a problem which has been treated already, in a much more powerful and general way, by far abler hands. For example, Thomson and Tait mention, as an example of motion of a solid in a liquid, the vibratory and irregular movements of such an object as an oyster shell sinking pretty slowly with a swaying motion when thrown flatwise into water. The rate of expenditure of energy necessary to prevent its sinking would, if these motions were forcibly produced, evidently practically coincide with the rate at which gravity works, when the rate of sinking is, on an average, uniform, and should be quite small. The case of hovering flight of a bird is manifestly closely analogous and that of progressive flight is similarly closely analogous to that of the same oyster shell, or a piece of slate, projected under water and forcibly maintained in a state of rhythmic motion. The only use of the investigation given in the present paper is to reduce the matter to figures, in a case sufficiently simple to enable us to use numbers supplied by existing experimental results.

[*Note added March* 21, 1899.—The error alluded to in the previous note was detected by checking equation (A) and that for H to see if the horizontal component of the acceleration was exactly periodic. Equation (C), as now given correctly, is the condition in question, with the additional information that each side is the work done. Mr. F. Purser, F.T.C.D., suggested that the wings as well as the body might be supposed heavy. The author has examined this point, and finds that, supposing, as before, that the engine, say a cylinder and piston

o whose rod the aeroplane is attached, works vertically, no difference is made in equation (C). The force P_a being inclined, has, or may have, a moment about the centre of inertia of the whole machine; the effects of this should be wholly periodic, but inasmuch as it appearsfrom experiment and otherwise that P does not pass through the centre of figure of the plane, and moves about in some way depending on the angle a, it would be impossible to test this condition without assuming details of dimensions, &c. Any actual bird or flying machine, must have some steering apparatus, capable of correcting disturbances of a rotational kind in both the vertical and the horizontal plane, but its management plainly cannot involve any materia alteration in the work to be done. The author conceives it to be possible, if not highly probable that the motion in flying is, in respect of direction, unstable. Small periodic terms may be assumed also to be added to V, but lead to nothing up to the order of quantities involved in neglecting the difference between cosine and radius.]

Some Simple Experiments with Aero-Curves.

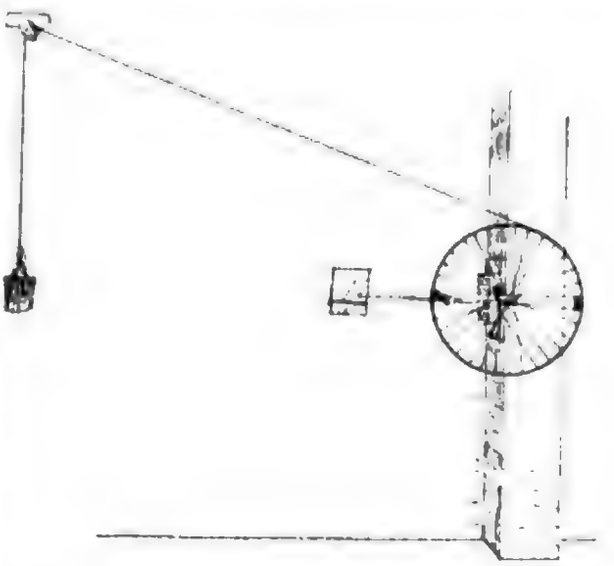
By A. A. Merrill, of Boston, Mass., U.S.A.

In the summer of 1898 I constructed a full sized gliding machine with which I made many short flights, ranging from fifty to one hundred feet. This machine was constructed on the plans of the Herring soarer used by Mr. Octave Chanute in his experiments on the borders of Lake Michigan during the summer of 1896, and, although I was not able to make so long a flight as Mr. Herring did, I acquired some knowledge of the management of the apparatus and the difficulties to be overcome. I used the Lilienthal form of curve, which is the arc of a circle, and the height of the curve is 1/12 the length of the chord.

My experiments showed not only that the problem of stability is a very great one, but that it is very necessary to find some more efficient form of curve than the circle, in order to reduce the power necessary to drive the machine through the air at a sustaining speed. I, therefore, determined to experiment with various surfaces, until I found one offering much less resistance than the one I was using.

The question of the best methods of experimenting next arose. I found that to make quantitative experiments, measuring accurately the lift and drift in some unit of weight measurement would involve the purchase of expensive and delicate pieces of apparatus, and I therefore determined to use the qualitative method. After much discussion with other members of The Boston Aeronautical Society, I finally concluded to use a small whirling table.

The illustration shows all the working parts, and the machine is easily described. The wheel, which is taken from a bicycle, is 26″ in diameter, and its axle is fastened to a pier in

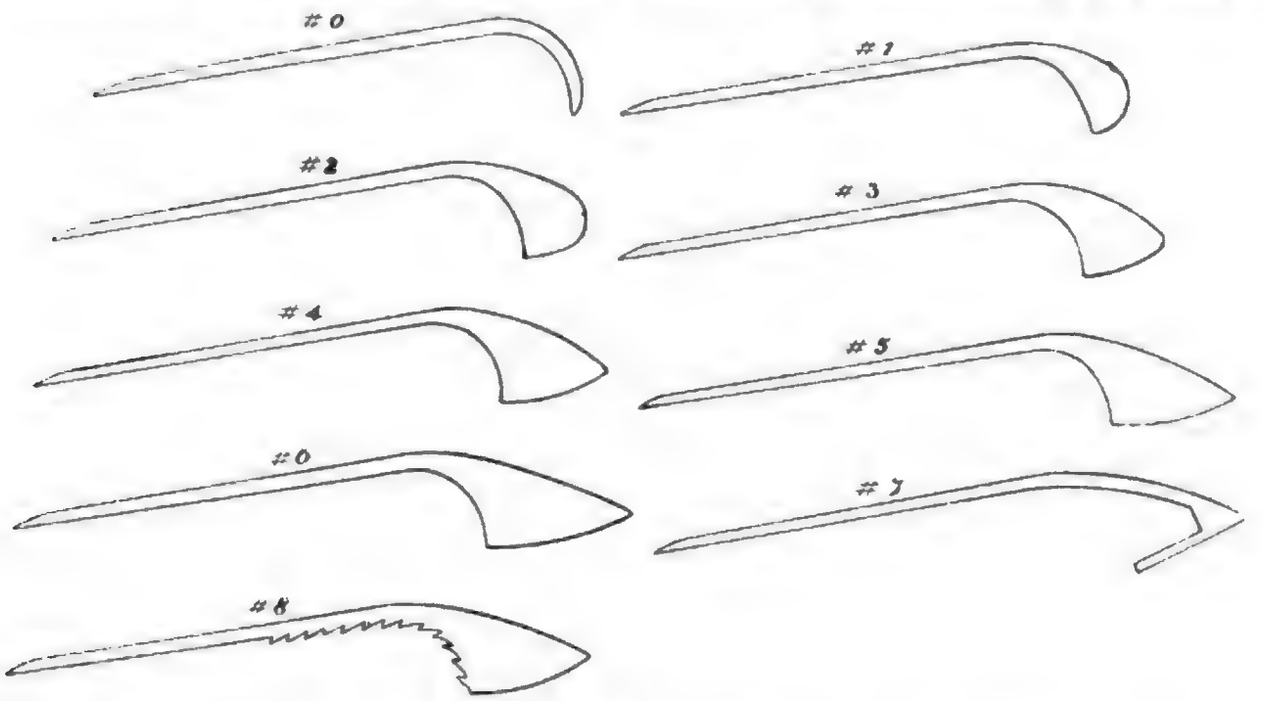


the cellar, where the experiments were made, in such a manner that the wheel revolves in a vertical plane. From a point on the periphery there is a standard of wood through the end of which a dowel is placed, and the outside end of this dowel is fastened to the surface to be tested. There is also a counterweight on the periphery to balance the wooden standard and dowel. This arrangement brings the plane of revolution of the surface parallel to and 8″ from the plane of the wheel, and the length of the dowel is such that the centre of the surface describes a circle 60″ in diameter. In the rim of the wheel is a pin over which a ring is placed. This ring is attached to a rope which goes through a pulley, and is fastened to a weight. There is also a counter which records the number of revolutions.

The mode of operation is as follows. A surface is fastened to the dowel at a known angle, the rope is attached to the wheel which is then wound up, raising the weight to the ceiling, and the reading of the counter is recorded. The wheel is then released, the weight falls, the rope leaves the wheel, and after it stops revolving a second reading is taken. By

changing the surfaces and keeping all the other factors constant, this machine enables us to determine which of any two surfaces offers the least resistance to forward motion. Much of my time was taken up in arranging the various parts in such a manner that the friction of the machine would be practically constant, and I obtained this condition after many trials, so that the greatest variation in any series of tests of the same surface was less than 2 per cent.

I next drew a series of surfaces to be tried, cross-sections of which are shown in the diagram, the surface marked 0 being the one recommended by Hargrave as being much



better than the Lilienthal surface. The other surfaces, except No. 7 and No. 8, are modifications of this curve, and differ simply in the thickness and shape of the front edge. The dimensions of the surfaces are as follows: No. 0 = 6″ × 6¼″, No. 1 = 6″ × 6½″, No. 2 = 6″ × 6¾″, No. 3 = 6″ × 7″, No. 4 = 6″ × 7¼″, No. 5 = 6″ × 7½″, No. 6 = 6″ × 7¾″. No. 8 is similar to No. 5 except for the ridges underneath, the use of which will be explained later; No. 7 differs from the rest principally in the shape of the underside. Care was taken that all these surfaces should weigh the same so that there would be no difference of weight to influence the records. All the surfaces were made of wood, and surfaces numbered 1, 2, 3, 4, 5, 6, were made by the addition of a piece of wood of the proper shape to the surface marked 0. In several series of tests of all the surfaces except No. 7 and No. 8, No. 5 was found to be the best. With No. 5 on the machine the wheel made 40 revolutions, while with No. 0 it would turn but 35 turns. This difference of 5 revolutions means a difference of 79 feet, so that with the same amount of energy expended in starting there is a gain of 14 per cent. in distance travelled. No. 2 and No. 3 gave about the same results, each revolving 32 times, while No. 4 and No. 6 revolved 39 times. It would seem, then, that to thicken the front edge and shape it properly tends to decrease the resistance, and that the limit to this thickening is reached in No. 5. In this the distance from the extreme front edge to the point where the under-surface proper begins is 20 per cent. of the whole distance to the rear edge. It may be noted in passing that in the Eddy kite, which flies at very high angles, the distance from the apex to the cross-stick is 18 per cent. of the whole distance from the top to the bottom of the kite, and I think, therefore, we may conclude that in flight the surface of this kite takes a position (by bagging) somewhat similar to the under surface of No. 5, which surface is shown by my experiments to offer much less resistance than other surfaces commonly used in kites and gliding machines. In my next experiments I modified the form of the under surface. Several people, particularly Mr. Lawrence Hargrave, of New South Wales, having advanced the theory that this surface (No. 0) caused the existence of a vortex under it which was used in soaring, I determined to see if this was true. I therefore took a small piece of writing paper to which I pasted thin strips of tissue paper in such a manner as to

Digitized by Google

overlap each other, and this paper was attached to No. 5 in the position shown in No. 8, and the surface was then tried. I was astonished to find that the addition of this small piece of paper caused the wheel to make three (3) more revolutions in every instance so long as the angle of the surface remained at 0°, and this difference was shown with every surface to which I attached the paper. This showed me that the vortex, so often spoken of by Hargrave, certainly does exist, and also that it can be made to do work in overcoming some of the resistance to forward motion, which would otherwise have to be overcome by the engine. The cause of this vortex is probably the formation of a vacuum which causes the retreating air to rush upwards and forwards to fill the empty space, thus forming a whirlwind under the surface. This whirlwind revolves in a vertical plane, so that the air which touches the surface in the curved portion is moving forward faster than the surface is, and, therefore, this air is in a condition to impart some of its energy to the surface, and this is done when the surface is roughened.

I then tried this piece of paper in many places, but the best results were obtained when it was in the position shown in No. 8, and I immediately constructed a surface having the roughness cut in the wood, and got the same results as with the piece of paper. My conclusions are that the vortex occupies the forward half of the under surface (this agrees with the results of Hargrave's experiments), and that if this portion is properly roughened the vortex may be used to advantage. No. 7 did not give good results, possibly because the vortex did not have a proper surface to form under.

Most of my experiments have been made with the surface at an angle of 0°, but I hope to carry them further and get qualitative results at other angles. I did, however, test the roughened under surface at large positive angles (such angles as kites would take), and in these cases the advantage of the roughness is less than when the surface is at 0° or —5°. The reason for this is, I believe, that at large positive angles, say 10° and more, the vortex cannot form as readily nor preserve its integrity as easily as at 0° or —5°.

This is as far as I have gone with these experiments, but they seem to show that Hargrave is right in stating that the existence of a wind vortex under a bird's wing is an important factor in soaring. I would like to have some experimenter use surface No. 8 in a large gliding machine, as I am confident that longer flights can be obtained with it than with either the Lilienthal or the simple Hargrave surface (No. 0).

I wish to say in closing that Mr. F. H. Wenham brought up the point that all birds' wings are extremely rough underneath, and in a paper read before the Boston Aeronautical Society, March 1st, 1897, put this fact forward as having a direct bearing on flight. The experiments which he was able to make at the time were not perhaps as convincing as they might have been; but in the light of Hargrave's experiments and my own work described above I am strongly inclined to think that Mr. Wenham is right, and that this roughness is important, though not in exactly the way he imagined it to be so.

I shall be very glad to hear what other experimenters have to say on this point.

NOTES.

Aeronaut's Adventure.—At Graz, in Styria, on June 26th, Signor Merighi, an Italian aeronaut, ascended in his balloon to a height of considerably over 10,000 feet, when the balloon burst suddenly and fell. At a distance of about 40 feet from the earth Signor Merighi threw himself out of the car. He broke one leg, and was taken up unconscious, but living, and was taken to a hospital. During his fall he wrote on a paper, found in the car—"Am dying contentedly, having reached my term." Signor Merighi states that at the height of 3,500 metres the balloon suddenly swelled to an enormous size, and though he immediately opened the ventilator, it burst with a tremendous crash, and was rent open from top to bottom. It formed, however, a kind of dome, which served as a parachute in the tremendous fall that followed.

Experienced French and British aeronauts, says the "Newcastle Chronicle," will be inclined to smile at the accounts of the perilous balloon ascent which has proved all but fatal to Signor Merighi. It seems plain that the adventurous Italian aeronaut might have done much better. Most balloonists up to their work would not have wasted time in scribbling dying messages on paper. They would have cut the car off, clung to the hoop, and in this way manœuvred the lightened balloon-parachute so as to land without injury whatever to themselves. Signor Merighi is to be sympathized

with, but not congratulated on his ballooning skill.

Kite Experiment on War Ship.—An experiment with kites from the bridge of the cruiser "New York" has been made to demonstrate to naval officers their value in giving signals at sea and in dropping life lines to ships in distress. Several large kites were sent up with pennant and signal flags attached. The latter were so attached to the cord that they could be lowered and changed in a short time. In making the life-line experiment a coil of cord is attached to the main kite line. By means of a small cord it was liberated when over a tug. One end was seized by tugmen and the other hauled in aboard the "New York." By means of this line a stout cable could be drawn from one boat to another.

Strange Accident to a Balloon.—An incident occurred during a recent military balloon ascent in Germany which has raised a question of extreme importance for aeronauts. Lieutenant von Sigsfeld, Engineer Tormin, and Second Lieutenant Hildebrandt, of the Berlin Military Balloon Department, ascended on Wednesday in a balloon filled with 1,300 cubic metres of coal gas and hydrogen. After eight hours' travelling the balloon was becalmed at a height of 8,000 ft. Hoping to find a current in a lower region Herr Sigsfeld pulled the cord to open the ventilator. To his astonishment it broke away in hand. On examination it was found that 2 ft. of the cord which runs up the inside of the balloon was decomposed and crumbled when touched. It is assumed that the sulphuric acid which is used in the production of the hydrogen had come into contact with the cord, perhaps through condensation. Fortunately no other lines or part of the balloon were affected, and after an anxious journey the balloon was finally landed in safety. The incident has led to a discussion of the question whether it is not better entirely to give up the use of hydrogen in aeronautics on account of the decomposing properties of sulphuric acid.—"Observer."

Naval Ballooning.—Lieut. Genty, director of the "Aerostatique" station at Toulon has been carrying out some interesting naval balloon experiments on board the battleship Jauregiberry. The chief object of the experiments was to discover the limit of distance at which the balloon could sight an enemy's ship without betraying its own presence. At an elevation of 400 yards from the bridge of the Jauregiberry the battleship Carnot could be observed at distances varying from five to 25 miles, whilst at the longer ranges of view, the battleship could only detect the balloon by means of powerful electric reflectors. As a result of the experiments it is held as firmly established that to a man on the look-out 20 miles away, a balloon is quite invisible.

The Andree Expedition. — A Reuter telegram from Stockholm says that the Anthropological and Geographical Society in Stockholm has received the following telegram from Herr Vathne, a shipowner at Mandal:—"Captain Hueland, of the steamship 'Vaagen,' who arrived there on Monday morning, reports that when off Kola Fjord, Iceland, in 65° 34′ north lat., 21° 28′ west long., on May 14 he found a drifting buoy marked 'No. 7.' Inside the buoy was a capsule marked 'Andrée's Polar Expedition,' containing a slip of paper, on which was given the following:—'Drifting buoy No. 7. This buoy was thrown out from Andrée's balloon on July 11, 1897, 10.55 p.m., Greenwich mean time, 82° north lat., 25° east long. We are at an altitude of 600 metres; all well. Andrée, Strindberg, Fraenckel.'" Herr Andrée made his ascent from Danes Island on July 11, 1897, at 3 o'clock in the afternoon, so that when the buoy was thrown out the explorer had only travelled seven hours and 55 minutes.

The Andree Search Expedition of the Swedish Professor Nathorst will sail during the present summer, with the express encouragement of the Swedish Government, of Nansen, and of several eminent scientists and financiers. The Swedish Parliament has voted him a grant of 40,000 kroner, 50,000 kroner have been contributed by private sympathisers; and his former ship, the Antarctic, is being furnished for the expedition. Nansen asserts, in a communication to the "Allgemeine Zeitung," that he has all along been of the opinion that the balloon must have been driven in a westerly or south-westerly direction, in which case it must have made for the eastern coasts of Greenland. Here, he imagines, the balloonists may have been landed, where they would not perish for want of food, since seals, reindeer, birds, the walrus, and the bear are richly abundant. The chances of their preservation, however, are considerably lessened by the fact that the last autumn passed without any communication from them. "Nevertheless," says Nansen, "I do not think that all hope is extinct." Next month it will be two years since Andrée started upon his daring flight.

Digitized by Google

Paris Exhibition of 1900.—There will be instituted during the Exhibition a series of international contests of sports, including athletics, fencing, shooting, cycling, sailing, and ballooning. Section X. (Aerostation) will take place in the annex of the Daumesnil Lake. Some valuable prizes will be given.

Foreign Aeronautical Periodicals.

ILLUSTRIRTE AERONAUTISCHE MITTHEILUNGEN (Strassburg).

April, 1899.—Dr. Moennichs.—Ortsbestimmungen im Ballon, von Professor Dr. S. Finsterwalder.—Conditions of success in the design of flying machines (Die Bedingungen des Erfolges im Entwurf von Flugapparaten), von O. Chanute, übersetzt von Rittmeister Warder.—Steilstehende Drachen, von Oberingenieur Arnold Samuelson.—Der Drachenballon der Jubiläumsausstellung in Wien, von August Riedinger.—Ballons pour rire, par M. Georges Bans.—Zur Theorie der Luftschifffahrt und Flugtechnik, von V. Turin, Privatdocent.—Petite expérience de Parachute dirigeable, par M. le Comte Jules Carelli.—Kleinere Mittheilungen: Ein neuer Drache Aëroplane, von Chas. Zimmermann. — Andrée-Nachrichten, von Carl Christensen.—Dr. Danilewsky's Versuche in Kiew.—Die beabsichtigte Verstaatlichung der meteorologischen Luftschiffahrt in Preussen.—Fahrten über den Kanal von Frankreich nach England.—Vereins-Mittheilungen.—Aus unseren Vereinen. — Aus anderen Vereinen.—Patente in der Luftschiffahrt. — Eingegangene Bücher und Separatdrucke.—Zeitschriften-Rundschau.—Allgemeine deutsche Sportausstellung München 1899. — Aus anderen Zeitschriften. — Neue Nachrichten.

ZEITSCHRIFT FUR LUFTSCHIFFAHRT (Berlin).

Heft 2. 1899. Februar.—v. Loessl: Der aërodynamische Schwebezustand einer dünnen Platte und deren Sinkgeschwindigkeit nach der Formel $V = \sqrt{\frac{g\,G}{\gamma\,(F+bv)}}$. (Fortsetzung.) Steffen: Zur Spannungs-Theorie.—Dienstbach: Ueber Luftwiderstand. — Kleinere Mittheilungen: Dienstbach über die unzutrefende Beurtheilung der Arbeiten von Maxim und Kress durch Koch und Lorenz. — Buttenstedt: Bemerkungen zu Platte's Idee. Weisse, Bemerkungen zum Buttenstedt'schen Flugprinzip.

Heft 3. 1899. März.—Trabert: Was erwartet die Meteorologie vom Registrir-Drachen? — v. Loessl: Der aerodynamische Schwebezustand einer dunnen Platte und deren Sinkgeschwindigkeit nach der Formel $V = \sqrt{\frac{g\,G}{\gamma\,(F+bv)}}$ (Fortsetzung.) — Kleinere Mittheilungen: Platte: Ueber das Fliegen. — Algemeine deutsche Sport-Ausstellung München. — Ueber die Bildung des Aéro-Clubs in Paris. Bücherschau: W. A. Tjurin: Zur Theorie der Luftschiffahrt.

Heft 4. 1899. April.—Dienstbach: A. M. Herring's neue Flugversuche. — Joseph Popper: Flugtechnische Studien. —v. Loessl: Der aerodynamische Schwebezustand einer dunnen Platte und deren Sinkgeschwindigkeit nach der Formel $V = \sqrt{\frac{g\,G}{\gamma(F+bv)}}$. (Schluss.) —Kleinere Mittheilungen: Dienstbach: Zur Entgegnung Buttenstedt's.—Platte: Ueber die Nothwendigkeit, das spezifische Gewicht der künstlichen Flugkörper jenen der Vögel mindestens gleich zu machen.

Heft 5. 1899. Mai. — Hinterstoisser: Einige Daten über die simultanen Ballonfahrten am 24. Marz 1899 in Wein. — Josef Popper: Flugtechnische Studien. — K. J.: Die Flugtechniker und die Mechanik. — Kleinere Mittheilungen: Dr. K. Danielewsky: Vergleichende Tabelle der Werthabschatzungen bei praktischer Anwendung eines Luftschiffes jetzigen Typus' und eines Flugapparates des Dr. Danielewsky. — Emil Jacob: Berichtigung. — Neue Schriften. — Vereinsnachrichten. Deutsche Verein zur Förderung der Luftschiffahrt zur Berlin. Protokolle der Versammlungen vom 27. Februar und 26. April 1899.

L'AERONAUTE (Paris).

Avril, 1899. No. 4.—Société française de navigation aérienne, séance des 6 et 20 avril 1899.—Notes sur l'enlèvement d'un cerf-volant par un temps calme au moyen d'une voiture automobile et sur les expériences de Blue Hill par M. Wentz.—Faits divers.—Ascensions internationales.—Expériences de ballons satellites par M. Mallet.—Nécrologie. M. Séraphin Magloire Jaubert. — Appareil pour la production de l'hydrogène, traduction de M. O. Frion.

Digitized by Google

Mai, 1899. No. 5.—Exposition universelle de 1900.—Liste des Comités d'installation de l'Exposition contemporaine et de l'Exposition centennale d'aéranautique. Liste des exposants provisoirement admis.—Société française de navigation aérienne, séances des 4 et 18 mai 1899.—Compte rendu par M. Lissajoux fils, de l'ascension exécutée par MM. Lissajoux père, Hioux et Poirier en 1870.

L'Aerophile (Paris).

Septembre - Octobre, 1898. Nos. 9-10. — Wilfrid de Fonvielle ; L'Histoire de l'Aérostation scientifique : M. Cailletet (1 gravure). — G. Besançon : Expériences du Ballon dirigeable de M. de Santos—Dumont (3 grav.).—G. Besançon : Progrés de la Navigation aérienne à l'Etranger.—Gustave Hermite : Ascensions internationales du 8 juin 1898 (6 grav.). — Louis Bartalot et Léon Flameng : Impressions de voyages aériens.

Novembre-Décembre, 1899. Nos. 11-12. — Wilfrid de Fonvielle : L'Histoire de l'Aérostation scientifique : Le Général Rykatchew (1 gravure).—Edouard Surcouf : L'Ascension du Véga (6 gravures).—A. Cléry : L'Aérostation à l'Exposition Universelle. — G. Hermite : L'Ascension de l'Alliance. — Wilfrid de Fonvielle : L'Aérostation à la Société Astronomique de France.—Ch. Ducos : Ma Première Ascension.—G. Garcia : La Traversée du détroit per le ballon l'Evening News.—V. Cabalzar : La Traversée de la Manche en ballon.

Janvier, 1899. No. 1.—M. le comte de Dion (Wilfrid de Fonvielle).—Le Baptême de l'Aéroclub (Ancelle).—Un Ballon dirigeable russe (A. Cléry).—Les Gaz liquefiés et les Ballons-sondes (Wilfrid Monniot). — Les ascensions aérostatiques en Allemagne (Georges Besançon).—L'Exposition des Sports en 1900 (Cabalzar).

Février, 1899. No. 2.—Portraits d'Aéronautes contemporains : M. A.-L. Rotch (Wilfrid de Fonvielle).—Les Ballons dans la littérature (Henry de Graffigny).—Les prétendues nouvelles d'Andrée (V. Cabalzar).—Nécrologie : A. Duté Poitevin (A. Cléry).—L'Aéro-Club (G. Garcia).—Conférences sur l'Aéronautique (P. Ancelle).—Bibliographie : L'Aéronautique (A. C.). — Informations : L'Aérostation militaire étrangère ; Manœuvres aérostatiques militaires à Toulon : Les Ballons a Déviateurs ; Un Aéroplane à Moteur a pétrole ; Voyage en Ballon ; Un Legs important : Le Legs Farcot.

Mars, 1899. No. 3.—Portraits d'Aéronautes célèbres : Jules Duruof (Wilfrid de Fonvielle). — Les Cerfs-Volants et la Metéorologie (Georges Besançon). — L'Aéronautique a l'exposition de 1900 (V. Cabalzar). — Un Criterium de la Navigation aérienne (Wilfrid Monniot).—Les Ballons dans la Littérature (Henry de Graffigny).—Revue des Moteurs légers (A. Cléry).—Expérience de Direction aérienne (Gustave Hermite).—Sur un Record allemand (Paul Ancelle).

Avril, 1899. No. 4.—L'Exploration des hautes Régions de l'Atmosphère : Expériences internationales du 24 mars 1899.—Les Ballons Sondes de M. Teisserenc de Bort (Wilfrid Monniot).—Le Lancer de l'Aérophile, no. 3, 24 mars 1899 (Gustave Hermite). L'Ascension du Balaschoff, 24 mars 1899 (Georges Besançon).—Rapport sur l'ascension du Balaschoff (Georges Le Cadet).—Aéro-Club.

Mai, 1899. No. 5.—Portraits d'Aéronautes contemporains : M. Abel Corot (Edouard Surcouf). Historique des divers projets d'exploration aérostatique du Pole Nord (G. L. Pesce).—La coupe des aéronautes (Georges Juchmès). — L'Aéronautique à l'exposition de 1900 (Wilfrid Monniot).

La France Aerienne (Paris).

No. 7. Du 1er au 15 Avril, 1899.—De l'horizontalité dans les machines aériennes, comte Jules Carelli. — Monsieur et Madame Duruof : souvenirs retrospectifs avec photographies. — Académie d'aérostation météorologique de France : Séance du 1er mars 1899.

No. 8. Du 15 au 30 Avril, 1899.—L'aéronautique à l'Exposition de 1900, avec figure : Georges Guibourg.

No. 9. Du 1er au 15 Mai 1899.—Une aéronaute oubliée : G. Guibourg.

No. 10. Du 15 au 31 Mai 1899.—Une aéronaute oubliée : Maret-Leriche. — Revue de presse. — Ballons pour rire extrait des Ill. Aëron. Mittheilungen. — Académie d'aérostation météorologique de France, séance du 19 avril 1899.

No. 11. Du 1er au 15 Juin, 1899.—Bonne foi aéronautique : Georges Guibourg. — Aéronautique au jour le jour. — Académie d'aérostation météorologique de France ; séance du 3 mai 1899. — Société aérostatique des Bouches-du-Rhône : statuts.

No. 12. Du 15 au 30 Juin, 1899.—La France aérienne à Lyon.

Digitized by Google

L'AERONAUTA. Rivista mensile illustrata dell' Aeronautica e delle scienze affini.

No. 7 a 12. Giugno 1898.—Aprile 1899.—Esperienze col paracadute dirigibile del Conte Carelli-E. Vialardi. — Macchina Acrea-G. M.—Sul volo degli Uccelli-Ing. Lanzerotti. —L'Avion-E. E. Vialardi Perchè non è ancora conquistato il regno dell' aria.-Silvio Da Rin Fioretto. — L'aria liquida e la liquefazoine dei gas-E. Vialardi.—La Società Aeronautica Italiana e la Conferenza Internazionale di Aeronautica a Parigi nel 1900 - Castagneris Guido. Fra i cervi volanti-E. Vialardi. — Motore leggero Hargrave - Icaro. — Fra i Palloni dirigibili - E. Vialardi. — L'Italia, progetto di aeronave dirigibile del Cav. Ernesto De Angelis - E. Vialardi. — Conferenza del signor V. J. de Turine.—Rapporto della Commissione Internazionale Aeronautica, riunione dal 31 marzo al 4 aprile 1898 - E. Vialardi. — Notizie varie. — Fra libri e giornali.

Notable Articles.

April *McClure's Magazine.*—"The War Kite." Capt. BADEN-POWELL. (Illustrated.) Similar to, but not same as, article in January *A.J.*

6. *Naval and Military Record.*—"Ballooning in the Army." General account, illustrated by four good photographs.

22. *Revue Scientifique* (Paris).—"Les Ballons Sondes." Review of book by M. DE FONVIELLE.

23. *Sunday Daily Mail.* "Gun Cotton in the Clouds." Illustrated account of Mr. Bacon's experiments.

May *Journal des Sciences Militaire* (Paris).—"Military Ballooning."
Strand.—"The Newest Flying Machine."

14. *Sunday Daily Mail.*—"French and German Aluminium Balloons." (Illustrated.)

19. *Daily Mail.*—"Shall Man Soar." Describing Mr. Hargave's soaring model.

20. *Golden Penny.*—"Cycling in the Air." Illustrated account of Myer's "Sky Cycle."

June *Strand Magazine.*—"Switzerland from a Balloon," with a series of interesting photos taken by Capt. Spelterini.
Pearson's Magazine.—"Ballooning after Shooting Stars." (Illustrated.)

3. *Golden Penny.*—"The Latest Attempts to Fly." Hargrave's, Herring's, and Danilwsky's.

7. *Le Temps* (Paris).—M. Don Simoni's Aeroplane Balloon. (Illustrated.)

23. *English Mechanic.*—"Cellular Kites."

Applications for Patents.

(*April, May, June*, 1899.)

7,264 April 6. C. A. CHAPPELL, London. Improvements in or Relating to Aerial Vehicles.

7,437. April 8. H. H. LAKE (Prof. E. Giampietro, Italy), Improvements in Aerostats.

7,442. April 8. D. M. BOWYER SMYTH, London. Improvements in or Relating to Propelling Means Suitable for Use in Flying Machines.

7,482. April 10. J. MUNRO, Croydon. Improvements in Aeronautics.

7,635. April 11. A. RIEDINGER, Liverpool. Improvements in Captive Balloons.

7,809. April 13. T. FRITSCH, Liverpool. Improved Apparatus for Use with Flying Machines.

8,019. April 17. A. H. P. BLUNT, London. Improvements in Flying Machines.

9,238. May 2. P. M. JUSTICE (Zimmerman Flying Machine Company, United States). Improvements in Tailless Kites. (*Complete.*)

9,596. May 6. D. M. BOWYER SMYTH, London. Improvements in or Relating to Propelling Means Suitable for Use in Flying Machines.

10,443. May 17. O. O. DOMON, London. Propelling and Steering of Balloons and Aerostats.

11,293. May 30. A. J. BOULT (L. E. de Manresa, Spain). Improvements in or Relating to Aerial Navigation. (*Complete.*)

11,508. June 2. T. MOY, London. Improvements in or Relating to Means and Appliances for Effecting Aerial Navigation.

Patents Published.

131. January 3. Aerial Machines. ZEPPELIN, G. F. VON, 19, Keplerstrasse, Stuttgart, Germany.

The aerostat comprises a framework of longitudinal tubes *r* interspaced by wire ropes *s*, covered with wire gauze or netting, and with an outer covering of silk. It is made rigid by vertical struts *v* joined by inclined stays, and by circum-

Digitized by Google

ferential hoops. It is divided into compartments containing large gas bags which nearly fill the compartments and small ones from which gas can be expelled by the expansion of gas in the large ones. It is very long compared with its diameter, and supports two cars containing driving-gear for the propellers t; a gangway l runs the whole length of it from which any part of it may be reached by ladders f. Several aerostats with cars containing goods may be coupled together and to a motor balloon by universal joints, and their cylindrical surfaces are joined by fabric. Horizontal steering may be effected by rudders q, and the inclination of the axis is adjusted by moving a weight b, which is suspended from a wire rope, along which it is made to travel by an endless band actuated by winches in the cars. The ropes b^2 are wound on fusees on the winches which always keep them tight. The weight may be replaced by a couple of nailing ropes. The weight or load between the several aerostats or balloons of a series may be adjusted by transferring sand, liquids, &c., from one to another through flexible tubes.

FIG. 1.

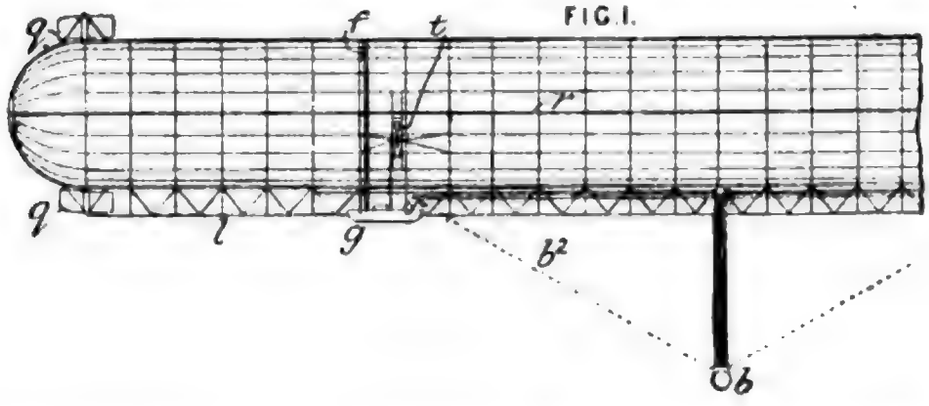


FIG. 2.



French Patents.

284,059. Czarniakowski. Dirigible Aerostat Based on the Natural Atmospheric Pressure displaced by the application of Centrifugal Force.

284,142. De Manresa. New system of Aerial Navigation.

284,331. Monpelas de Dax. Compressed Air Propeller for Dirigible Balloons.

284,713 Mary. Train Aerostat.

284,889. Malezieux New system of Propulsion and the Direction of Aerostats.

285,205. Zarski. New Disposition of Platform for Dirigible Balloons.

285,269. Suter. Dirigible Aerial Vehicle.

United States Patents.

(April, May, June, 1899.)

Nil.

Digitized by Google

ENGINEERING LIBRARY
620.5 Lacker no. 9
A245

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4 1910

THE AERONAUTICAL JOURNAL



No. 12. OCTOBER, 1899. VOL. III.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	73
MEETING OF THE AERONAUTICAL SOCIETY..	73
THE ZEPPELIN AIR-SHIP (*Illustrated*)	75
LONG DISTANCE BALLOONING..	78
WAR BALLOONING IN CUBA	83
FATAL ACCIDENT TO MR. PILCHER (*Illustrated*)	86
NOTES: PROF. LANGLEY'S MACHINE—THE PEACE CONFERENCE—BALLOON ACCIDENTS—THEORY OF BALLOON ASCENT—MORE CROSS CHANNEL TRIPS—KITES FOR METEOROLOGY—AERONAUTS VERSUS CYCLISTS—IMPORTANT OBSERVATIONS	89
OBITUARY—M. GASTON TISSANDIER	91
RECENT PUBLICATIONS	91
FOREIGN AERONAUTICAL PERIODICALS	92
NOTABLE ARTICLES	93
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED - FOREIGN PATENTS, &c.	93

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCALLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

OCTOBER, 1899.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on September 12th. The following gentlemen were elected Members:—

Sr. MIGUEL G. FLORES, Spain.
Capt. T. S. H. WADE, Lanc. Fus.
Lt. H. OSBORNE MANCE, R.E.

The following gentleman was proposed as Honorary Member:—

Mr. F. H. WENHAM.

The following additions to the Rules of the Society were duly passed:—

ADD TO RULE IV.—"Any member who has not paid his subscription for two consecutive years, notice having been sent to him during each year that such was due, shall be liable to have his name removed from the list of members."

NEW RULE VIA.—"In order to meet the wishes of those who desire to be connected with the Society, but who do not care to become ordinary members, certain persons may be admitted, by ballot, as Associates. Their subscription to be five shillings per annum. They will be entitled to attend all meetings of the Society, of which due notice will be sent to them, but will not be entitled to other privileges of membership."

B. BADEN-POWELL, MAJOR,
Hon. Sec.

Meeting of the Aeronautical Society.

A meeting of this Society was held on Friday evening, the 26th July, at the Society of Arts, John St., Adelphi, under the presidency of Mr. E. P. Frost. Several papers were read, and a number of working models exhibited.

(The full text of these papers not having yet been sent in, must be printed separately.)

DR. BARTON, on being called upon to read his paper, on "a new navigable balloon," alluded to the pleasure it gave him to be elected a member of the Society, and hoped to be able to do his share to advance the science, for the advancement of which the Society was founded. During the reading of his paper, Dr. Barton made frequent reference to the aeroplane frame, a large model of which was suspended before the platform. The general idea of the invention is an elongated balloon propelled by a screw in the car, and having below it a large aeroplane, the inclination of which can be altered at will, so as to cause the balloon to ascend or descend as required. Dr. Barton read several accounts from different newspapers, describing the experiments he had made with his model machine, which was propelled by clockwork. The first experiment took place on March 10th. He had wished to ascertain what the machine would do in still air, so he had it taken to the Town Hall, Beckenham, and had tried it there, in order that it might be uninfluenced by any currents of air. On that occasion when the aeroplane had been put level, and the rudder placed at the correct angle, the machine had turned round and round continuously, which spoke well for the efficiency of the rudder in still air, as the

Digitized by Google

space in the Beckenham Town Hall was very limited. The next experiment was on the 16th March out in the open. It was a very unfavourable day for the experiment, and although on the whole it had proved satisfactory, considering the gustiness of the day, the experiment had not been completely successful. On that occasion, said Dr. Barton, he had not mastered the arrangements of the rudder, and something went wrong with the propelling machinery, which was very weak. The report appeared in the Daily Chronicle of the 17th March.

The next experiment was on the 8th May, and was a very much more successful one. On that occasion, Dr. Barton wound up the clockwork to the full, and the machine travelled 4 miles in about 23 minutes. He had made a hole in the aerostat before starting it off, otherwise it might have gone for a longer distance. It went straight forward until the clockwork stopped and then—and this Dr. Barton considered a very important point—the machine went round and round like any ordinary balloon.

Another trial took place on 26th May in the open, but since then, Dr. Barton had been too busy to make any further trials. He produced several photographs of the machine in mid-air, but explained that they were not good owing to the great difficulty of photographing such an apparatus in rapid motion across the sky.

Mr. Pollock criticised the model as having no outlet for the gas to escape if it ascended to a great height. Mr. Davidson asked what was the greatest speed actually obtained with the model.

Dr. Barton replied that he did not think the actual speed was more than 2 miles an hour, but then the clockwork weighs only 4 lbs., and the propeller is about 1 foot across. He was now getting a new clockwork motor made of about 10 or 12 lbs., which would be much more powerful.

Mr. Pierce said, as one who had watched this matter from its initial stage, that he had witnessed several successful experiments, and firmly believed that we are landed at least one step nearer the desired haven.

Mr. Reid remarked with reference to the use of gutta percha for the balloon, that this substance is apt to rot from the absorption by the gutta percha of the hydro-carbons present in the gas. That was a point which he (Mr. Reid) had experimented upon when he invented the material known as "Velvril," which material Dr. Barton had referred to in his paper. This material does not absorb those hydro-carbons present in the gas. Mr. Reid added, "I think we are very much indebted to Dr. Barton for giving us the result of his experiments. It is practical experiment we want, and not discussion (Hear, hear). I do not know whether Dr. Barton has found any difficulty in the collapsing of the front part of his balloon in driving it through the air, but if so, it would be quite possible to obviate that by placing the propeller in front. I believe that has been tried successfully in France. If you place your propeller in front, instead of pushing your balloon, you drag it through the air currents, and in that case the tendency for the front part of the balloon to collapse is not nearly so great." (Applause.)

Dr. Barton said he was very pleased to have met the inventor of this material—"Velvril," and hoped to make many more experiments with it. As to collapsing, he thought that with a larger machine, it might be necessary to have an aluminium casing over the front part of the balloon. It would not weigh very much, and it would be perfectly rigid, and would prevent the air forcing the apex in.

The next paper was read by Mr. D. M. B. Smyth, on a new form of aerial propeller. In this, he explained the blades were normally plane surfaces without pitch. But on rotating, a pitch was automatically created. Mr. Smyth then exhibited some models, in which the propellers were rotated by twisted india-rubber, after the fashion of the well-known toy butterflies.

The third paper was by Mr. Cochrane, who exhibited a well constructed little model with a brass compressed-air engine, the pistons of which acted on 4 reciprocating wings, each consisting of a number of blades. These blades were so arranged as to have a valvular action, opening during the up-stroke to let the air pass and closing to form a powerful wing on the down stroke. The power given by the engine, however, Mr. Cochrane explained, was not so great as he could desire, and though the wings beat rapidly, the apparatus was not able to rise in the air.

The Chairman then called upon Mr. Davidson, who, he said, had some models to show the Meeting.

Mr. Davidson (who was received with applause) said he had had no intention of showing anything that evening, but having completed the small model they now saw, he thought it might interest the members if he brought it down. (Hear, hear.) He did not intend to work his model on that occasion, as it was necessary to have "live" air, and also

Digitized by Google

that the machine should be dropped down in order to get "way" on it before it could be started. One thing was most important if they were going to travel through the air, and that was that they must keep their equilibrium. If they were going to make any machine, they must be sure that that machine would remain vertical. He had been studying that point, and in the model he then produced, he had a means by which a body gliding through the air would absolutely maintain its equilibrium. He maintained that that model was the first mechanical contrivance that had ever yet been made that would automatically keep its equilibrium—or its horizontal stability—in gliding through the air. Professor Langley had a means of keeping his machine horizontal, but in that case it had been propelled exactly like a ship in the water, and not like a bird. Mr. Davidson did not explain the mechanism of his invention, in which the tail was apparently acted on by a pendulum inside the structure, which, in the event of the machine losing its equilibrium in one direction, immediately caused it to be recovered in the other. Mr. Davidson stated he intended to make experiments with models of 3 ft., 6 ft., 12 ft., and 24 ft., and in that way he hoped to obtain very valuable data.

Mr. Moy remarked that pendulums have been patented over and over again for that very purpose.

The Chairman.—It is extremely gratifying to find that so many persons are hard at work on this most interesting subject. Personally, I have not had a great deal of study in balloons, but I have in navigating the air by mechanical means. We are led to believe by Dr. Barton that his experiments have been successful, and there is nothing that succeeds like success. He speaks of "buoyancy," that is to say, I suppose he means that his machine will be equal in weight to the weight of air in which it sails, but I fear it would be more or less at the mercy of the winds under those conditions. I trust that that little piece of mechanism of which he has told us may lead him to success. With reference to Mr. Smyth's new theory of horizontal flying, I am inclined to think that gravitation is an agent in favour of natural flying, although Mr. Smyth seems to overthrow that idea. If I understand him rightly, he overthrows the force of gravitation by a force that he creates in his machine. Perhaps the form of the leading feathers in a bird's wing, acting upon the force of gravity, tends to send the bird on. I am sure we are all extremely obliged to the gentlemen who have given us these papers this evening. What Mr. Davidson has said has been extremely interesting. I can quite understand that his model would not act unless it had an eight or a ten foot fall. He is not able to show us the peculiarity of the mechanism, but he has told us that it works automatically, and can preserve its "horizontal stability." I should like to say again that I am sure we are all very much obliged to each of the gentlemen who have given us the benefit of their papers this evening. (Applause.)

Mr. Davidson proposed a vote of thanks to the Chairman, and with his, coupled the name of our very energetic Secretary, Captain Baden-Powell. (Applause.)

The Meeting then closed.

The Zeppelin Air-Ship.

What is without doubt one of the most important attempts to solve the problem of the navigation of the air is now being made on the shores of the Bodenzee, in Wurtemberg. The general idea is that of what has hitherto been called a dirigible balloon, but this term hardly describes the huge ship with its metal framework and outer cover containing a number of balloons. It is nothing more or less than an aerial steamship.

The inventor is Count Zeppelin, a Lieutenant-General in the German Army, whose name was well known at the time of the Franco-Prussian War, for the daring reconniassances which he carried out. Before that, he had attended, in a private capacity, the civil war in America, and his first balloon ascent was in one of the military balloons of the Federal Army. More recently he has been employed on the staff of the king of Wurtemberg, and in this capacity has attended several state functions in England. The count has for many years been interested in the study of aerial navigation, and is said to have spent something like £25,000 on his experiments. Then, with several very influential supporters, he formed a company with a capital of one million marks (£50,000), and started on his present venture. A commission was appointed to enquire into his plans, and report on the probabilities of success or otherwise. When asked whom of notable scientific men he would like appointed, he replied "Prof. Helmholtz, because he is the greatest opponent of my theories." The Professor was appointed, went deeply into the subject, and finally owned that the matter was well worth trial.

Digitized by Google

The general principle is to construct a very long balloon—the length giving the requisite buoyancy without increase of resistance by sectional area. This principle appears to be sound enough, since we know that ships have sometimes been cut in half, and an extra length added without the speed of the ship being thereby diminished. But such great length necessarily involves a framework to keep the balloon rigid. This framework consists of a number of large hoops with longitudinal pieces connecting them and diagonal wire stays to impart rigidity. So far, the idea is very much the same as that so ably brought forward by Mansfield in his book on "Aerial Navigation." But times have changed, and the materials used are such as even Mansfield had scarcely thought of. The framework is almost entirely constructed of aluminium, lattice-girders about 7 ins. wide being formed of bars, the whole riveted together with aluminium rivets. This enormous structure, somewhat resembling a vast bird cage, looking as frail as a cob-web, yet really of marvellous strength and stiffness, weighs about 7,260 lbs.

Over all this framework is stretched hempen netting, both to the inside and outside of the girders, so that there are two layers of netting, as there are to be two skins to the balloon. This immense framework, over 420 ft. in length, is subdivided by network partitions, in each of which a gas bag of corresponding shape is inserted, so that altogether there will be something like 17 balloons. Outside all will be a cover of water-proofed silk, both to make a smooth surface for the air and to protect the balloon, and the space between the two will tend to mitigate the varying influences of temperature on the gas.

The ends of the cylinder, which is nearly 37 ft. in diameter, are of an ogivale shape—that is, similar to the bow of a boat, or head of a projectile—the point being formed of a nearly hemispherical aluminium cap.

Under almost the entire length of the vessel runs a gangway or gallery, a couple of feet wide, of aluminium plate. This adds rigidity to the hull as well as forming a means of communication. The two cars are also made of aluminium plate, looking like water tanks, and are rigidly connected to the main framework.

Not the least interesting feature of the construction is the method of housing this aerial monster. A huge raft has been made nearly 500 ft. long, on which a great wooden house has been built. At one end is an immense doorway with canvas curtains to close over it, which consequently has very much the appearance of the proscenium of a theatre. This structure alone is said to have cost £10,000. The advantages of such a floating stable are many. First, if it had been built rigidly on shore, and it were required to draw out the balloon (not unlike drawing an enormous sword from its scabbard), it can well be understood that, should the wind be blowing strongly against the door, or on one side of the house, there would be great difficulty in doing so. By mooring the raft, however, at the bow only, it naturally swings away, so that the doorway is always to leeward, and the airship can be drawn out with the wind. Then an open space of water all round, without trees or buildings to interfere is most desirable in starting the machine, and in the event of an accidental precipitation, no very serious damage is likely to come to either men or machine. Add to these the economy of not having to buy or hire land, no risk of damaging crops, and comparative ease of keeping inquisitive sightseers at a respectful distance, and the great advantages of the system may be realized.

There is, moreover, another device to aid the task of starting the balloon. The great house-boat is in reality a floating dock, containing within it a long raft, on which the balloon rests. When the start is to be made, this raft is towed out of the house, and there is the balloon all ready for ascent.

But this great floating structure is not the only accommodation provided for the undertaking. Near by is a floating shed containing a number of pontoons to carry the gas tubes for inflation. Then there is the boat-house to accommodate several oil-launches and other boats, while on shore some great sheds are erected, wherein the balloons are prepared and varnished, and the usual offices and draughtmen's rooms complete the establishment. The whole affair is thus undertaken in no small way. Four engineers are employed to carry out the inventor's designs, and from 40 to 70 artisans are usually at work under their orders. It is a veritable dockyard, which one can hardly realize is solely established for the coming ships of the air.

Then as regards the propulsion, another novelty comes in. Count Zeppelin is convinced from the experiments he has made, that small screws revolving at a high velocity are more efficient than those which are large, and rotated at a slower rate. The line of propulsive power should evidently be as near as possible coincident with the centre of resist-

Digitized by Google

ance, and therefore, instead of placing the propellers underneath the balloon, as has so often been done in former attempts, he places them at each side of the vessel on a level with the central axis. Two pairs of propellers, each being a four-bladed screw, about 3 ft. 6 ins. diameter, are thus arranged, one pair near the fore part and one near the after part of the ship. Two cars, to carry the engines are placed below, each containing a benzine Daimler motor of about 15-horse power. These engines are connected to the screws by bevel gearing and aluminium tube shafts. In order to avoid any danger of firing the balloon, as occurred to Dr. Woelfert some years ago, the ignition of the engines is electrical, and the exhaust pipes are carefully closed in with double wire gauze.

The question of propulsion is the gist of the whole matter. It may be laid down as an axiom that a navigable balloon to be a practical success *must* be able to attain a speed of at least 20 miles an hour. Anything much less than this would be insufficient to stem a moderate breeze, and if so huge a vessel is wafted away from its dock, it would be most difficult to house elsewhere, and would run a great chance of being wrecked by the wind. The inventor is very hopeful of being able to attain a speed of at least 22 miles an hour, and this seems not improbable on considering theoretically the data.

The count has been testing his propellers in a very practical way. He has rigged a framework on a large boat in which the engine is placed, and the screws being fixed in position above and geared to the engine just as they would be in the balloon, but with shorter connections. On revolving the screws (at 1,100 revolutions per minute), the boat is driven along through the water, and has thus attained a speed of 12 miles an hour. By taking into consideration the relative densities of the resisting mediums and the surface of resistance, a very good comparison can be made, from which the inventor obtains his calculation of 22 miles an hour.

If we further consider the matter by taking other data, we get equally encouraging results. Thus, on comparing this with the most practicable navigable balloon we have hitherto had, viz. "La France," we find that the latter with about 8-horse power, attained a speed of 14 miles per hour at its best. Its sectional area was about 520 sq. ft., or a little more than half that of Count Zeppelin's vessel. Roughly speaking then, we may say that we have four times the engine power to drive double the resistance, which, other things being equal, should give half as much speed again, or 21 miles an hour.

Other tests may also be put. For instance, the formula given by Dr. Pole and de'Lome

$$v^3 = \frac{385\,r}{S\,\Sigma}\,(A\,d - B)\,d\,l$$

works out the velocity at 38 ft. per sec., or 26 miles per hour.

Or, again, the propulsive effort to drive such a vessel through the air at the rate of 22 miles an hour should be about 120 lbs. Maxim obtained a thrust of 2,000 lbs. with his 360 horse-power engines, which in proportion should give also 26 miles per hour. Davidson and Walker with a propeller very little larger and with a slightly higher rate of revolution, obtained a thrust of 40 lbs., which multiplied by 4 would give 160 lbs. So that all points to the probability of a sufficient speed being attained.

It will be useful to consider for a moment the effect of head winds on a machine capable of going 22 miles an hour. As far as daily *mean* velocity of the wind goes, only on an average of about one day in a week is it greater than this in England, though the *maximum* pressure of occasional gusts might often imply a greater rate. Then it would, of course, be impossible to go to windward at all. Still even this does not nullify the usefulness of the vessel. Mornings and evenings are usually comparatively calm, and plenty of opportunity is thus given for *experiment* or for short trips. When carrying out long journeys, the great question will be how to house the huge vessel when a strong contrary wind does come on to blow.

Landing will also be a very ticklish manœuvre, as anything like a bump might cause the whole framework, and especially the propeller connections, to be bent.

As for steering the craft, two vertical rudders are provided for changing the horizontal direction of progress, while the vertical course and the general level of the vessel is regulated by a shiftable weight to be drawn, by means of ropes, towards one or other end of the ship. This latter arrangement may appear somewhat clumsy, and if the vessel, as a whole, proves successful, we predict that some other contrivance will be adopted for regulating the horizontality.

With the idea of being able to ascend to a considerable height in the air, the balloons are, in filling, not to be fully distended, so as to allow for expansion in rarefied regions; but smaller auxiliary gas bags are sandwiched in between, fitted with valves, so that they can

Digitized by Google

be emptied of gas as desired, while the main balloons remain with their charge of gas intact.

It is still a matter of some doubt as to when the machine will be ready to make its initial trials. Delays have been frequent, and it was expected that it would have been ready before this. But all is now very nearly complete. The framework is practically finished. The balloons, made by a professional aeronaut, are delivered. The engines and propellers are in working order. All that is needed is to place them all together, and inflate the balloons. This is to be done by means of 2,600 tubes of compressed gas, which are to be floated out in large pontoons, and connected by pipes with the balloons. Of course, for such an experiment as the first ascent, it will be necessary to await for the most favourable weather, as without doubt many trials will be necessary before the craft is in a really workable condition.

When the ascent is to be made, the count hopes to command his vessel with two engineers in each car. These men have each been going through a course of ballooning to accustom themselves to their new calling.

With only five men there will be a large margin of buoyancy left for ballast, perhaps 3,000 or 4,000 lbs., which should enable a long journey to be performed.

We reproduce here an illustration of the floating house, also a rough diagram from the patent specification, but hope in our next number to be able to give a series of photographs of the machine.

Long-Distance Ballooning.

LIEUT. H. OSBORNE MANCE, R.E.

[From the *Field*.]

A report has been going the rounds of the press abroad to the effect that a party of German aeronauts contemplate making an experimental long-distance balloon trip, starting from Germany and travelling in an easterly direction, the object of the voyage being to discover experimentally how long a balloon may remain in the air before coming to the ground.

Whether there is any foundation for this report or not, there can be no doubt that experiments of this kind are necessary for the advancement of the science of aeronautics. Long-distance ballooning has been hitherto neglected, as far as practical trials are concerned. A few long voyages may have been made, but the ill-fated Andrée appears to have

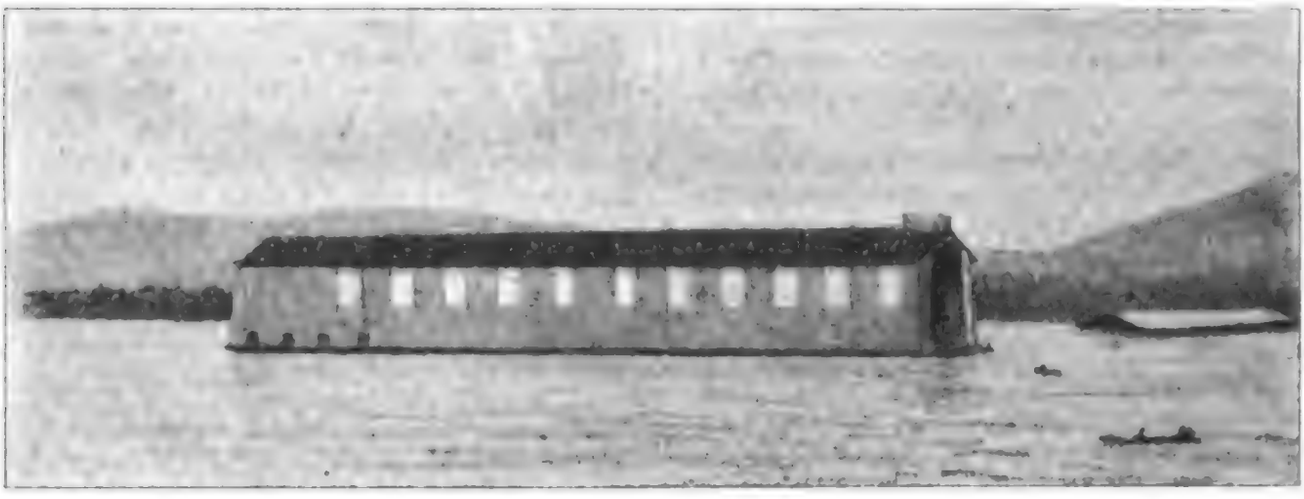


FIG 1.

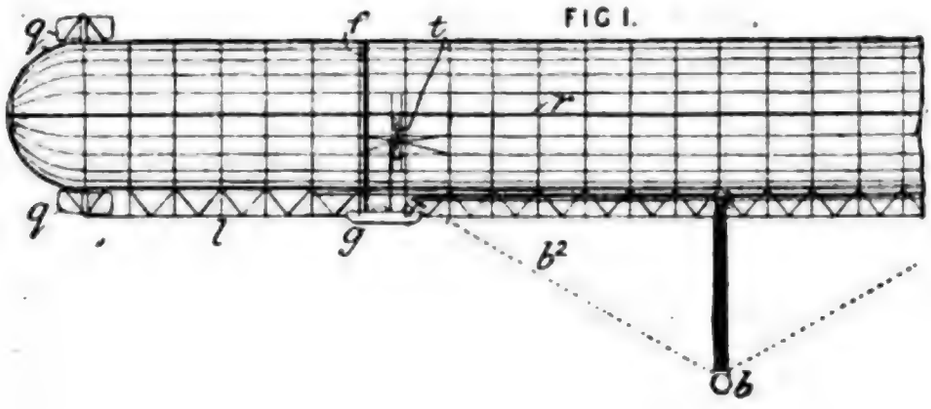


FIG 2.



Digitized by Google

been the first to devote systematic attention to this special problem, in connection with his attempted voyage to the North Pole. As a general rule, the art of ballooning has for the last few decades been utilised for either public ascents of comparatively short duration, made by professional aeronauts, accompanied perhaps by one or more enterprising passengers desirous of experiencing the sensation of ballooning, or for the purpose of scientific investigation of the higher strata of the atmosphere, and very little has been done to promote the science of ballooning itself. Possibly this is to be accounted for by the expense inseparable from experiments of this nature, involving, as they often do, the use of special apparatus, the design of which can only be satisfactorily accomplished after much thought and many fruitless trials.

Up to the present day the voyage of longest duration is that of Andrée, who had just been forty-eight hours in the balloon when he despatched his pigeon message. The next longest are thirty-six hours in 1892 by M. Mallet, twenty-four and a half hours by M. Hervé in 1886, and twenty-four and a quarter hours accomplished by the great Leipzig balloon in 1897 with eight people in the car. The distance covered on this latter occasion was 1032 miles, probably the longest balloon journey on record.

As regards speed, short journeys of under two hours have been done at ninety and eighty-eight miles per hour, and the Channel has been crossed at a rate of seventy-seven miles per hour. In a recent voyage made by some German officers 420 miles were covered in six hours.

The idea of long-distance ballooning suggested itself to Andrée during a voyage across the Atlantic, when he was so impressed by the regularity of the trade winds that he contemplated a trans-Atlantic balloon trip. He was, however, forced to abandon the idea, as he felt that funds would not be forthcoming for an expedition which would savour to most people of absolutely useless foolhardiness. When his expedition to the North Pole was decided on he was recommended to make some overland experiments on a large scale to verify the theories on which he was about to stake his life, but this advice was not taken, probably for the same reason—lack of funds. However, Andrée cannot be said to have started on his famous voyage without having previously put his apparatus to the test, as several successful journeys were made by him and by his colleagues across the Baltic and in the Mediterranean.

Long-distance ballooning may be divided into two classes of journeys; those in which the destination is immaterial, and those in which it is intended to reach some pre-determined goal. To succeed in the first case, assuming favourable weather, requires the solution of only one problem, that is—to keep the balloon in the air as long as possible. In the second case it is, in addition, necessary that the balloon should be steerable to a certain extent.

The short duration of ordinary balloon voyages can be accounted for by the following principal causes. Firstly, the small size of the balloons used; secondly, the leakage of gas through the open neck, and through the envelope of the balloon; and thirdly, the impossibility of getting an absolutely free balloon into a state of stable equilibrium at a uniform height in the air, and the consequent necessity of constantly throwing out ballast to compensate for the gas lost by successive rising and falling of the balloon. It is obvious that other things being equal, the larger the balloon the more ballast and gas can be lost before the buoyancy is exhausted, and it is universally admitted that for long journeys a large balloon is necessary. Andrée's balloon had a capacity of 162,000 cubic feet, and the balloon to be used in the projected German trip is still larger, having a capacity of 42,380 cubic feet more, or a total of 204,380 cubic feet, and a lifting power of 120 cwt., besides the weight of the balloon and car.

As regards the leakage of gas, it is absolutely necessary to have an outlet for the gas to avoid all danger of bursting the balloon, owing to the pressure caused by the gas being expanded or by a diminution of external pressure, but there is no necessity for an outlet of 12 to 18-in. diameter permanently open and permitting the diffusion of the gas from the interior and the entrance of air from the outside. An obvious remedy is to have at the neck a valve opening only to let out gas at a certain pressure, far less than that which would cause any dangerous strain to be imposed on the envelope of the balloon, but which would prevent any loss of gas due to minor variations of temperature and pressure, and would also preserve the gas to a large extent from an admixture of air. Andrée used a valve of this description designed to open at a pressure of 10 millimetres = 4 in. of water. Much leakage is also prevented by an efficient top valve. This valve may be either of the ordinary or of the rending pattern. The latter is practically gas-tight, but limits the control of the balloon, and once opened cannot be

Digitized by Google

closed again. This pattern was used in the recent cross-Channel trip by the *Times* and *Daily Chronicle* balloon.

The leakage through the envelope, though negligeable in the ordinary balloons used for free ascents, compared with the losses due to other causes, is a serious consideration in balloons designed for long journeys, or to be used as captive balloons—another case where it is desired to maintain the buoyancy as long as possible. This question has been carefully investigated by all military ballooning establishments, to whom it is of great importance that the expenditure of gas should be a minimum on active service, and formed one of the principal difficulties Andrée had to contend with.

It is beyond the scope of this article to enter into details of the means employed to reduce this leakage to a minimum, but as examples of the results obtained, it may be mentioned that Andrée's balloon was said to leak only 1 cubic foot per diem; English war balloons, made of skin, leak 3 per cent. in twenty-four hours; and French balloons, made of fine pongee silk coated with varnish, lose 4 per cent. in the same time. The balloon which is said to be the one selected for the proposed German expedition is that which did duty as a captive balloon at the Berlin Industrial Exhibition, so that the amount of leakage to be expected should be accurately known from the consumption of gas required to maintain its buoyancy, due allowance being made for the different rate of diffusion of hydrogen gas if coal gas was used in the first case. Should the leakage be unsatisfactorily large, steps will no doubt be taken to render the envelope more gas-tight.

It has been suggested that cylinders of compressed hydrogen should be taken instead of ballast, as these could be used to replenish the gas, and the empty cylinders as discardable weight. Neglecting the possible inconvenience resulting from a rain of cylinders from on high, and their unsuitability in other respects as ballast, the amount of gas which could be taken up in this way would be extremely small. For instance, the French cylinders used for carrying gas in the field for military balloons weigh 1000 lbs., and only carry 1400 cubic feet of gas at 3000 lbs. per square inch pressure. English cylinders weigh 95 lbs., and carry 150 cubic feet of gas at a pressure of 1950 lbs. per square inch.

It is evident from the above remarks that the chances of achieving a record are greatest if the journey is made in a climate and season where the atmospheric changes are neither great nor frequent. It has been recommended that in hot climates the top of the balloon should be screened from the sun by a light awning, but this would not appear to be effective except in equatorial latitudes.

Up to the present there has been no satisfactory method devised whereby a perfectly free balloon can be made to remain for any length of time at a constant altitude without a prodigal expenditure of gas and ballast far in excess of that due to the gradual leakage of gas. Could this be effected in the case of a large gas-tight balloon, and the loss of ballast be consequently reduced to that necessary to compensate for the gradual leakage of gas through the envelope, a free balloon could be maintained in the air for a time limited only by the desire and the purse of the aeronaut. But, although this condition has not yet been attained in the case of a perfectly free balloon, there is no doubt that the addition of a suitable trail rope, the end of which is allowed to drag along the ground, affords a very fair solution of the difficulty. This trail rope, the use of which has been known for many years, acts as a species of automatic governor, any tendency of the balloon to rise being counteracted by the gradually increasing weight of rope carried by the balloon; while, if the balloon commences to descend, it is relieved of the weight of the additional length of rope allowed to trail along the ground, a position of equilibrium being automatically arrived at in each case. After the height of the balloon has been once adjusted, the only discharge of ballast necessary will be that due to leakage of gas, and the full importance of having a gas-tight envelope becomes at once evident.

It has not been generally recognised that a great deal depends on the size (both length and thickness) and the material of the trail rope. The friction of a trail rope dragging over land or water retards the progress of the balloon to an extent depending on the quantity and nature of the rubbing or immersed surface of the rope and on the speed of the balloon. In consequence of this the trail rope, when there is any wind, will be at an angle to the vertical, and will lie in a catenary curve. Now it is fairly evident on the face of it, but can be verified quantitatively by mathematical investigation, that the thinner and shorter the trail rope, and the greater the resistance, the flatter will be the catenary, and the greater the chance of the balloon being blown down to the ground or sea. Also, the thinner the rope the greater the length which must be immersed to compensate for any given variation in buoyancy, and certainly the greater the resistance

Digitized by Google

for the same *weight* of rope immersed, and the more chance of entanglement with obstacles below.

Consequently, when a trail rope is employed to regulate the height of a balloon, it should be as long, heavy, and smooth as possible, always providing that for an over-sea journey the lower part of the rope at least is not heavier than water. The quantity of ballast taken is not thereby reduced, as the trail rope is as good as ballast, and can be eventually used as such if required. The partial failure of the *Times* and *Daily Chronicle* experiments during the cross-Channel trip made by their representatives was doubtless due to the use of too light a trail rope. Andrée had to have a certain weight of trail rope to counteract the varying buoyancy of his balloon at different temperatures. This weight he divided into three ropes of different lengths so as to make each rope more manageable, and both to divide the risk of entanglement and enable him to detach a portion of a rope if it caught in anything without materially lessening the efficiency of the trail ropes as a whole. The ropes were 1205 ft., 1042 ft., and 1017 ft. long, and weighed about 2204 lbs. in all. The lower portions were coir rope of specific gravity not greater than water. Statistics regarding rope friction on land and in water would be of value in this connection; the friction of a rope in water appears to be greater than that of the same rope on land. Andrée found it necessary to reduce the friction of his ropes as much as possible by impregnating them with vaseline. It is, of course, just possible that the friction of an ordinary rope is too great and retards the balloon to such an extent that it is blown down dangerously near the ground or sea. In this case some other material will have to be employed for the trail rope, perhaps leather.

There is at present a slight element of uncertainty as to the most advantageous materials and dimensions for a trail rope, but therein lies the more reason why experiments should be made to solve this problem. There are, however, people who are sufficiently callous and apathetic in matters scientific as to view with suspicion, if not with absolute disapproval, any proposal to drag heavy trail ropes over towns, villages, buildings, or even cultivated fields. But there is no necessity for the trail ropes to be employed from the very start, and the first stage of the voyage might be effected with the ropes stowed away in the car (which fact would reduce the chances of a hitch at starting) ready to be let down as soon as some less inhabited country is entered upon.

Once the trail rope has begun to drag along the ground, the only way of ascending clear of the ground is by throwing out ballast of a weight equivalent to that of the portion of the rope resting on the ground. But fortunately this sudden undesirable discharge of ballast need not be resorted to except in a case of emergency, for it was proved experimentally that by the adoption of the steering arrangement employed by Andrée most obstacles which can be seen a reasonable distance ahead can be avoided.

Leaving out the trail rope, which we will suppose to be already decided on, the additional weight of the sail and fittings required is comparatively small, and can be arranged to be discarded as ballast if necessary; the additional risk is nil, a certain measure of utility is assured, and the possibility of achieving still more satisfactory results well worth the slight additional trouble involved.

The invention of this trail rope and sail combination is usually attributed to Green early in this century, but others give the credit to Professor Kratzenstein, of Copenhagen, who is said to have suggested it a few years after the balloon was invented, about 1784. The recorded experiments made with the trail rope and sail combination date back from 1886, when M. Hervé obtained a deviation of 65° to 70° by using this means. A detailed account of the apparatus employed and the conditions which prevailed would be of great value. After this come the preliminary experiments of Andrée in 1895 to 1897, a short land trial by representatives of the *Times* and *Daily Chronicle* in November last; a cross-Channel trip in December by the *Times* and *Daily Chronicle* balloon, during which brief experiments were carried out; and an experiment by some German officers this spring. Andrée is said to have obtained a deflection of 12°, and to have based a hope on his experiments of attaining a deviation of 30° on either side of the direction of the wind. The *Times* and *Daily Chronicle* balloon deviated 14° on each side of the direction of the wind, on the occasion of their first trial; and in the cross-Channel trip, during successive brief trials, recorded a deviation of 30°, the conditions differing from the former trip in that the sail was over twice as large, and the balloon appeared to be retarded more. The details of the experiments made by the German officers are not published, but the aeronauts reported that the steering gear acted to their complete satisfaction.

For the benefit of those readers who are not already acquainted with the principle of this method of steering balloons, it may be

mentioned that the resistance of the trail rope dragging along the ground by retarding the balloon causes a breeze relative to it. The sail, which is made fast more or less in a vertical plane depending on the method of fixing, is adjusted so that it is inclined horizontally to the direction of the above breeze, which acts on it and deflects the course of the balloon somewhat in the same way that a rudder causes a lateral force to act on the stern of a boat.

The conditions are too varied and unknown to admit of a reliable theoretical computation of the maximum possible deflection under the most favourable circumstances, or of an exact prediction of the combination best suited for the purpose. Nevertheless the main principles governing the design of the apparatus are fairly clear, and, neglecting the case of an elongated balloon, which it is not intended to consider here, the principal points to be aimed at are as large a sail area as possible and the maximum safe retardation of the balloon. The sail can always be trimmed at the most advantageous horizontal angle for steering by shifting the point of attachment of the trail rope to the main hoop. In this latter connection the angle which the plane of the sail makes with the *vertical* deserves consideration. If only one inclined sail is used, this should always be kept on the windward side of the balloon when trailing. If this is done, unless the balloon is blown over by the wind at an angle greater than that made by the plane of the sail to the axis of the balloon, the wind due to the retardation of the balloon tends to exert an upward force on the sail, which acts to a slight extent like an aeroplane, and assists in preventing the balloon from being beaten down by the wind. If the sail is on the lee side, the balloon is exposed to a downward force due to the sail acting as an inverted aeroplane. Whatever combination of sails is adopted, and probably two or three can be advantageously introduced, it might be well worth while trying to arrange that they can be trimmed so as to present at least a vertical surface if not a favourably inclined one to the wind. Perhaps also it might be worth while rigging up a small aeroplane under the car so as to obtain a slight temporary increased buoyancy at the very moment when it is most required to prevent the balloon from being blown down dangerously near the ground or sea.

It would seem as the result of the experiments which have already been made that it is not unreasonable to hope for a deviation of 20° to 30° when the conditions are better known, and the apparatus is improved correspondingly, and, though the problem of dirigeable balloons will not thereby be solved by a long way, and obviously, indeed, cannot be completely solved by this method, yet even this amount of control over the direction taken opens up large possibilities in long-distance ballooning. Andrée's well-thought-out and daring scheme to reach the North Pole by balloon was not by any means devoid of the elements of success, and there is no reason why the Pole should not be discovered in this way if the direction of the wind could be counted on as being within 20° of true north. It would be advisable, however, before committing the lives of brave men to the risk of the comparatively unknown dangers involved by a similar attempt, to carry out large scale experiments over land and sea in more congenial climes, and in places where failure need not necessarily spell disaster.

First of all there is need of short preliminary voyages, after the manner of the recent cross-Channel trip of the *Times* and *Daily Chronicle* balloon. By this means indications will be obtained of the most suitable appliances, and the experience thus gained would justify, for example, an attempt to cross the Atlantic in a balloon. The regularity of the trade winds encourages the attempt, which would possibly be most favourably undertaken along the wind belt between, say, Gibraltar and Venezuela. The direction of the wind being inclined to that of the belt according to Ferrel's law, it would be imperative to use the sail and trail rope or other means of steering to avoid the belts of calm to the north and south of this wind belt. In case of failure there would always remain the chance of obtaining assistance from passing vessels. There does not seem to be any reason to doubt the practicability of this voyage, which would be justified as a preliminary to another attempt to reach the North Pole by balloon.

Whatever may be the exact nature of the reported trials to be made by Berlin aeronauts, any further investigations which may tend to throw more light on the subject of such importance as aerial navigation cannot fail to be followed by world-wide interest and attention.

It has occurred to me since I wrote my article on this subject that for over-sea voyages at least it might be a good plan to make the trail rope, or ropes, not only smooth enough for safety, but as smooth as possible, and to have at the end of a wire some suitable form

Digitized by Google

of obstruction which could be let down and dragged behind when it is desired to retard the balloon. The advantages would be that, except when it is intended to steer the balloon out of the direction of the wind, the retarding apparatus would be drawn up clear of the water and the trail rope, while fulfilling its height-regulating functions, would not diminish the velocity of the balloon to an unnecessary extent; also that the amount of obstruction could be arranged to be varied according to the needs of each case. Experiment alone can prove whether the rope can be made smooth enough to justify this expedient.

It would be of considerable value if reliable observations could be made, during the experiments, of the velocity of the balloon relative to the earth, and of the velocity of the wind relative to the balloon, the sum of these two giving, of course, the velocity of the wind relative to the earth. Two ingenious methods were adopted by Andrée for measuring the former, but they are only applicable over land or where fixed points are available for observation. Letting alone complicated and probably unreliable methods depending on the pull of the rope and the length immersed, the only practicable way seems to be to use a small log. The velocity of the wind relative to the balloon can be measured by an anemometer on the balloon.

M.

War Ballooning in Cuba.

The following extracts from the official report of Lt.-Col. J. E. Maxfield, U.S. Volunteer Signal Corps, to the Chief Signal Officer, U.S.A., are interesting, and give a very different version of the affair to that quoted from the New York "World" in this Journal for January last:—

"The apparatus already in the possession of the corps embraced 1 silk balloon, 1 small generator (which was out of repair), 1 small gas compressor (also out of repair), 180 steel tubes for holding compressed hydrogen, 1 balloon wagon, 1 wagon for the carriage of tools and miscellaneous supplies, and 5 wagons for the carriage of the gas tubes. Both the compressor and generator, while large enough for use for purposes of instruction, were too small to give good results in actual service. * * * Both in the repairing of the apparatus already on hand and in the ordering of new, great difficulty was had in finding firms who could, without delay, perform the necessary work. In spite of these difficulties, by the middle of May all the apparatus on hand at the beginning of the war had been placed in thorough repair, the work upon the new apparatus was approaching completion, and orders had been placed for the necessary tools and material for the generation of gas. During the latter part of this work I had the assistance of Mr. L. B. Wildman, aeronautical engineer, afterwards first lieutenant, United States Volunteer Signal Corps. As fast as the materials and apparatus were ready they were shipped to Tampa, Fla., at which point it was decided to erect the permanent gas plant, at least temporarily. Much delay occurred in the shipment of the balloon material from Fort Wadsworth, owing to its great weight and the lack of men to properly handle it, the garrison at that time being small and engaged in other work. In addition to having placed in thorough repair all the apparatus on hand, there was purchased 1 portable gas generator, 1 semiportable generator of large size, 3 balloons, 1 compressor of the capacity of 25,000 cubic feet per day, 1 large sheet-iron gasometer, 5,000 feet of balloon cable, an additional cable reel so designed as to be easily placed in an army wagon and dismounted at will, 1 portable boiler for the operation of the gas generator, 1 large stationary boiler for the operation of the compressor. In addition there was also purchased a large variety of tools of all kinds suitable for working both in wood and metal, to enable repairs to be readily made in the field. Large quantities of iron turnings and sulphuric acid for the generation of hydrogen were also shipped to Tampa. By the middle of May all orders had been placed and work had progressed, so that it was possible for me to leave New York and to proceed to Tampa for the purpose of organising the balloon companies. * * * Ten men of the Signal Corps, United States Army, from Chickamauga, 4 from Atlanta, and 10 from Major Greene's command at Tampa, had in the meantime reported to me for duty. Major Greene also placed at my disposal the services of Second Lieut. George C. Burnell, United States Volunteer Signal Corps, and the promotion of Sergt. Walter S. Volkmar to the grade of second lieutenant gave me two officers. * * * The next day was the one devoted by the troops to the loading of the transports. It was found that no assignment to any transport had been made for the balloon detachment, and it was only after some time and by the order of the commanding general that such assignment was obtained. The cars con-

Digitized by Google

taining the balloon material were found early in the morning, and by placing an officer upon the train of which they formed a part, these cars were at last brought opposite the designated transport, the 'Rio Grande,' and the supplies unloaded. Loading upon the transport at once began, but owing to the fact that the carboys of sulphuric acid could not be placed in the hold but had to be hoisted up over the ship's side, it was not until the next morning that the loading was completed. Lieut. James R. Steele, United States Volunteer Signal Corps, reported to me before the sailing of the expedition. On June 22 the landing of the troops of the expedition began at Daiquiri. * * * Landing was completed on the morning of the 28th, the equipment loaded upon seven army wagons, and the march to the front began. Owing to the condition of the roads it was found necessary several times to partially unload the wagons at bog-holes, and it was not until that night that Siboney was reached. I reported to the commanding general that night and received instructions to continue the march the next morning and report to him at whatever point should be established at his headquarters upon my arrival. The detachment reached headquarters early in the afternoon of the 29th, but a heavy rainstorm prevented any work being done with the balloon that day. On the next day the balloon was spread. It was found that the extreme heat had softened the varnish so that the two sides of the envelope were stuck together. It was also found that either from scorching or the use of improper varnish portions of the balloon were badly rotted. This balloon was the old balloon in the possession of the corps at the beginning of the war. After the envelope had been fully spread, numerous small holes in it were found, as well as several rents of considerable extent. It was in such condition that had the ascents to be made in time of peace it would have been felt unsafe to use it. The rents were carefully sewn and covered with adhesive plaster and the balloon inflated. Three ascents were made that afternoon—the first by myself and Sergeant Baldwin, Signal Corps, United States Army; the second by Second Lieut. Walter S. Volkmar, General Castillo, of the Cuban Army, being carried as a passenger; and the third by the chief engineer officer of the Fifth Army Corps and myself. These ascents resulted in an increase of knowledge as to the direction and course of roads and streams immediately in our front. The fact that the Spanish fleet of Admiral Cervera was in the harbour of Santiago was at last definitely settled. It could not be determined, however, how strongly the fortifications in our front were held, nor could they be located except with the greatest difficulty. A most flattering verbal report as to the value of the balloon in war was made by the chief engineer officer to the commanding general, with the recommendation that it be employed during the battle planned for the next day. That evening verbal orders were brought me by the chief engineer officer of the Fifth Army Corps from the commanding general to report with the balloon, at as early an hour as practicable, at El Poso, which was to be the headquarters of the commanding general during the battle, and that there I would find the chief engineer officer who would accompany me in the ascents. The balloon was secured in the most sheltered place possible for the night, and the detachment rose at daybreak and proceeded to replace the gas which had been lost during the night. It was also found that new rents had been caused by the wind during the night, which had to be repaired before the balloon could be used. As soon as these repairs were completed the detachment took up its march for El Poso, towing the balloon by means of captive ropes. * * * Here I met Lieutenant.-Colonel Derby, and the balloon was carried to a place in the river bottom, about a quarter of a mile to the rear, and an ascent made, Colonel Derby and myself occupying the basket. From this point a message was sent to the adjutant-general of the corps, setting forth the movement of troops both at El Caney on our right and upon the road to our front, which led to the hill at San Juan. Under orders from the chief engineer officer, the balloon was then pulled down to within a few hundred feet of the ground—the occupants of the basket still remaining in it—and towed towards the front until a more suitable position for viewing the intrenchments at San Juan could be found. It was supposed that the balloon would be halted at El Poso, and that point taken as a station for the balloon detachment, as had been originally intended. As this was not done, a statement was made by me as to the results of artillery firing at balloons in experimental work abroad, and the conclusions to be drawn from such, and the fact stated that in my opinion it was unwise to carry the balloon farther to the front. No formal protest, however, was made, as it was felt that the chief engineer officer was the representative of the commanding general and that his desires were to be carried out. As a consequence, the balloon was carried rapidly to the front until it was immediately in the rear of the troops, who were

Digitized by Google

then deploying for an attack upon the block-house and trenches on the San Juan Hill. As no further progress to the front could be made, the balloon was then carried across the bed of the San Juan River and into a large meadow just to the right of the road and river. In passing through the trees and brush along the river banks the ropes holding the balloon captive became badly tangled in this brush, and no movement for a time was possible; nor, for the same reason, could the balloon be given the necessary elevation to enable it to do its best work. Nevertheless, from this position the fact was determined that the intrenchments on the San Juan Hill immediately in our front were strongly held, and a message to this effect sent to the commanding general with the suggestion that the artillery upon the hill at El Poso should reopen its fire upon them. This was done. The attention of the occupants of the basket was given almost solely to an examination of the ground held by the enemy and that immediately in their front, and it is impossible for that reason to state what was the disposition of our own troops in the immediate vicinity, most of whom were hidden by the brush. It was noticed, however, that dismounted cavalry were deploying in the open meadow in which was the balloon, about fifty yards in our front. It was at that time that the enemy opened fire. This fire appeared to be musketry alone. In a very few minutes it became apparent that the balloon had been struck, as there was a decided loss of gas, and the rope having not yet been cleared from the brush I gave the order that the balloon should be pulled down, hoping to be able to disentangle it, carry it to the rear, repair the holes in it, and replace the lost gas from the tubes which still remained full. This order was obeyed, and for twenty or thirty minutes the detachment was busy endeavouring to disentangle the captive cord and extend it along the bed of the river. During this work the detachment was exposed to a heavy musketry fire, from which they were fortunately fairly well sheltered by the banks of the river, and although the leaves oftentimes fell in showers from the bushes and trees overhanging the bank, but one man, Private Heywood, Signal Corps, United States Army, was struck, he receiving a wound in the foot. An examination of the balloon having shown several holes in the upper portion, and the loss of so much gas as to render the further use of it impossible, orders were given to secure it and to retreat along the river bottom. This was done, and the detachment in a short time reported at El Poso. Later in the day Second Lieut. Walter S. Volkmar was instructed to make an examination of the balloon and report whether it had been so badly damaged as to render its recovery useless. He reported that the gas had entirely escaped, and that there were numerous holes and rents in the envelope, which would render it totally unserviceable for future use in the field where facilities for repairs upon a large scale were lacking. He, however, folded the balloon, and placed it in the basket, and it was afterwards recovered and brought to Siboney. * * * The difficulties met with in securing the rapid manufacture of apparatus needed have already been referred to. No less difficulty was found in securing the services of experts in the varnishing and care of balloons. While in New York innumerable applications for enlistment were received from professional aeronauts, but it was found to be wholly impossible to obtain the services of men of the class desired. The American aeronaut, making his ascensions as he does for purposes of exhibition only, desires to land in the shortest possible time. It is therefore a matter of little importance to him whether his envelope is made highly impermeable to the gas contained in it or not, and the result is that he knows little or nothing about the proper processes to be employed in making and keeping the envelope highly impermeable. It is understood that the services of two French experts were offered after I left New York, but only at the most exorbitant salaries. In spite of the difficulties met with, however, it can be said that within five weeks after the declaration of war the Signal Corps was able to put a fully equipped balloon train in the field, and that by the time the companies of the Volunteer Signal Corps had been organised and were ready for service another train was practically completed. At the time of the cessation of hostilities, one set of equipment was at Santiago de Cuba, with all the necessary apparatus and material for making balloon ascensions, although work could not have been done with it as rapidly as would have been the case had a fresh supply of tubes containing compressed gas been available. Another balloon section was at Tampa, likewise fully equipped. As regards the conclusion to be drawn from the work of the balloon section in the campaign of Santiago, in its bearing as to the value of the use of the balloon in warfare, a few remarks may be useful. As has been stated above, the use of the balloon in this campaign was very limited. Had it been brought ashore and used daily from the time of landing until the day of the battle upon July 1, it is believed

Digitized by Google

a large amount of exceedingly valuable information would have been obtained. As it was, the few ascents made on the afternoon of June 30 were not rich in results, although some additions to the map of the country in our front were made possible by them. On July 1 at least two items of information of value were obtained by the use of the balloon. These were as follows: First, the fact that the intrenchments at or near the hill of San Juan were strongly held by the enemy. The obtaining of this information resulted in the opening of fire by the battery at the hill of El Poso earlier than would have otherwise been the case. Second, the official report of Brigadier-General Kent, commanding the First Division, Fifth Army Corps, as published in the press, states: 'The enemy's infantry fire, steadily increasing in intensity, now came from all directions, not only from the front and the dense tropical thickets on our flanks, but from sharpshooters thickly posted in trees in our rear, and from shrapnel apparently aimed at the balloon. Lieutenant-Colonel Derby, of General Shafter's staff, met me about this time and informed me that a trail or narrow way had been discovered from the balloon a short distance back leading to the left to a ford lower down the stream. I hastened to the forks made by this road, and soon after the Seventy-first New York Regiment of Hawkin's Brigade came up. I turned them into the bypath indicated by Lieutenant-Colonel Derby leading to the lower ford, sending word to General Hawkins of this movement. This would have speedily delivered them in their proper place on the left of their brigade.' The country in which the army was operating was covered with brush and trees, and, moreover, was hilly. Such a country is the one least likely to afford to the balloon a good opportunity of proving its usefulness. Movements and positions which upon a flat, open country could have been easily distinguished from the basket of a balloon, and in no other way, were hidden or only discerned with the greatest difficulty. * * * The balloon used in the Santiago campaign was one of about 15,000 cubic feet capacity. This raised the two observers, the necessary instruments, and the captive cord, but not enough ballast could be carried to give easy control of the balloon in case it had broken away; furthermore, even in a slight wind it was found that the lifting power of the balloon was sensibly lowered. It is, therefore, believed that balloons employed for military reconnaissance should be of at the least 18,000 cubic feet capacity. The use of gas compressed in steel cylinders for the inflation of the balloon seems to be the best method until new processes of generation of hydrogen shall have been discovered, thus enabling portable generators of light weight to be utilised. The present portable generator to be of sufficient capacity is almost too large and too heavy to be moved over rough roads, while the weight of the material for the generation of the gas is excessive. It would, therefore, seem preferable, wherever possible, to place the generator at the base of operations and to keep the balloon supplied with gas by the shipment to the front of tubes. The carriage of large quantities of sulphuric acid is difficult when carried in carboys, as was the case during the Santiago campaign. It was found that the stoppers often were knocked out or the necks of the carboys broken while being transported. On the other hand, the carriage of acid in lead-lined iron cylinders, while much more convenient, offers the objection that even the slightest hole in the lead lining will lead to leakage of the acid, and possibly a serious accident. It is also believed that it would be better in the case of field operations, where expense is a matter of minor importance, to substitute ingots of zinc for the iron turnings ordinarily used. By doing this a greater rapidity of generation would be secured and less transportation would be required. Taken as a whole, the present apparatus for balloon work is cumbersome, and can be transported over bad roads only with great difficulty. There is a wide field for improvement, and it is to be hoped that in the coming years sufficient appropriations may be secured to enable a thorough series of experiments to be made looking toward the finding of new methods of generation and the lightening of the apparatus employed and the weight of material used."

The Fatal Accident to Mr. Pilcher.

It is with the most profound regret that we have to chronicle, at the last moment, an event of the most sorrowful and regrettable nature. It is an event not only detrimental to the progress of aerial navigation, and deterring to others pursuing the same promising line, but it is one which deprives us of one of our most ardent workers, one of the cleverest, most practical, and most energetic of aerial experimenters.

Digitized by Google

Percy Sinclair Pilcher was born in January, 1866. He early entered the Navy, but retired after seven years' service, and took up civil engineering. After regularly going through the shops at Glasgow, he was for a couple of years with the Maxim Nordenfeldt Company, and lately became a partner in the engineering firm of Wilson and Pilcher. He joined the Aeronautical Society in March, 1897, being elected to the Council in November of that year. Mr. Pilcher first began experimenting with soaring machines about 1894, when he got a Lilienthal machine, and later improved upon it, building several new models. He adopted a method of experiment which was a distinct step over Lilienthal's descents from a hill top, and that was to tow the machine by means of a long cord over the flat, and thus to rise somewhat on the principle of a kite, but with the string attached to the front edge. It was on Saturday, September 30th, that Mr. Pilcher gave his last exhibition. He had been staying with Lord



Photo by *S. Koenig.*

PERCY S. PILCHER.

Digitized by Google

Braye, at Stanford Park, near Market Harborough, and a number of friends from the neighbourhood came over to witness the event. Among those present were his poor sister, the Hon. A. Verney Cave, Mr. Henniker Heaton, M.P., Major Baden-Powell, and others. The afternoon proved very unfavourable, with frequent light showers and a gusty wind. However, after making some trials with the kites which Mr. Hargraves presented to the Aeronautical Society, it was decided to try some flights with the old soaring machine, a beautifully made new three-decked machine, somewhat similar to that tried by Mr. Chanute, being also brought out. The string, a very light cotton line, perhaps 300 or 400 yards long, was attached to the fall of a tackle, which was drawn away by a couple of horses. By this arrangement the speed of the horses was multiplied several times. On the first trial the apparatus appeared to go very well. It rose easily into the wind after a short run, but just as it was getting up the string broke, and Mr. Pilcher gently descended to the ground, just as any large bird might do. The machine was then taken back for a fresh start, the inventor remarking that the rain had made the machine very heavy, and that it was difficult to get up the desired speed. The second attempt was more successful still, the apparatus easily rising up to about thirty feet. (It was, of course, extremely difficult to judge with any certainty the exact height.) Just then, a snap was heard, the tail was seen to collapse, and the apparatus dived forward, and probably turned completely over before it reached the ground, a shattered wreck. Mr. Pilcher lay motionless, moaning and unconscious. It was painfully evident that his left leg was broken high up on the thigh, but no other traces of injury were apparent. Luckily, two doctors were present among the onlookers, and promptly rendered assistance. The unfortunate victim was with some difficulty got free from the wreckage, placed on a door, and carried to Stanford Hall. After a careful examination by the doctors, a somewhat hopeful bulletin was issued, stating that there was no apparent injury to head or spine. Consciousness, however, did not return, and after lingering on through Sunday, the sad end came on Monday morning.



An examination of the wrecked machine revealed the fact that the probable cause of the accident was due to the canvas of the tail shrinking from the wet, and thus breaking the bamboo stretcher. Though, of course, this conclusion is but a surmise.

Thus ended what was, from a scientific point of view, one of the most successful flights ever made by man. The fact of rising up from the level ground many feet into the air, solely by the aid of being towed by a very light line, is a

Digitized by Google

triumph, proving that if that small amount of pull had been derived from a screw propeller such as Mr. Pilcher had actually made, though never tried, it would have gone equally well. But there is an important moral to be learnt from this abrupt descent. Such an apparatus *must* be so constructed that if one little portion breaks, the balance of the machine will not be wholly destroyed thereby.

We are able to reproduce a photograph of Mr. Pilcher in his machine, which if not a good one, is of great interest as having been taken but a few minutes before the fatal accident.

NOTES.

Professor Langley's Machine.—Notwithstanding some awe inspiring and highly suggestive accounts which have recently appeared in the papers with respect to this apparatus, we have the highest authority for stating that the trials have been conducted in great privacy, and that no details will be published just yet as to what is being done. Most of the newspaper reports are wholly unreliable, many merely referring to those experiments which this inventor conducted over three years ago, and others having been concocted by the fertile brain of the "copy-writer."

Balloon Accidents.—During the last few months there have been more slight accidents to balloons than is usual or desirable. The first incident to relate can perhaps hardly be called an accident, though it was not the fault of the aeronaut in charge that it was not so. Mr. Reuben Bramhall was to make an ascent in his balloon from Bradford, taking two passengers, Mr. J. J. Schmidt and Mr. T. Croft. The aeronaut, presumably with the idea of impressing the audience with his *savoir faire*, stood on the edge of the car at the start. But through bad management the balloon dragged through some bushes, and swept Mr. Bramhall off his perilous perch, while the balloon, relieved of his weight, shot up into the air with the two unfortunate amateurs. Luckily they kept their heads, and successfully brought the balloon to earth, after a trip of 27 miles.

The same aeronaut a few days later had another nasty mishap, which certainly does not look well for his capabilities as an aeronaut. During the inflation of his balloon, a strong gust dragged it from its moorings, and drove it across the ground, where it got badly torn on the fencing, the aeronaut himself being dragged some distance entangled in the netting.

On last Bank holiday, there occurred what one of the evening papers described in its poster as "A terrible balloon catastrophe at the Crystal Palace." It seems that owing to an oversight, the balloon ascended with the neck tied up. After rising about 500 ft., a rent appeared, said to be caused by the internal pressure of the gas, and the balloon descended so rapidly that it came down on the roof of a house, but luckily without the occupants of the car receiving any injury.

More serious accidents have unfortunately occurred abroad. An Italian military captive balloon broke loose in July, carrying with it not only an officer and a corporal who were in the car, but also a soldier who had held on to the rope in hopes of keeping the balloon down. Those in the car tried to draw up the unfortunate man, but after a time he let go, and was dashed to pieces on the banks of the Tiber. The aeronauts then made a very rough descent, the corporal sustaining a fracture of the leg.

At Benzeville, in France, an aeronaut, named Bernard, made an ascent, but finding his balloon had too little lift, he dispensed with the car, and sat upon the hoop. It is supposed that the gas from the balloon issuing through the neck must have asphyxiated him, for he was seen to let go his hold and fall to the ground from a great height, being killed on the spot. The *Revue Scientifique* says this brings the number of victims of ballooning up to about 200.

The Peace Conference.—The great conference at the Hague, so boldly heralded as the foundation of the international compact to absolutely do away with war and bring everlasting peace, has ended. And with what result? A very detailed modification of a certain form of bullet has been, by some nations only, prohibited; the use of asphyxiating gases, a system of warfare not only never practically tried, but probably never even seriously considered, has been condemned; and thirdly, the discharge of projectiles or explosives from balloons or aerial machines has been prohibited (for five years) by all the nations. It is this last resolution that is of special interest to our readers, since the perfected aerial machine was always supposed to be the most powerful engine of war, chiefly on account of the ability to drop explosives on any desired

spot. But there are still many doubtful points to be decided. Does this preclude an aeronaut from dropping any article from a balloon with intent to do damage? If not he may rain down as many bullets as he likes, and can presumably drop over anything that is not explosive, such as fire brands, molten lead, or acids! Then, again, what is the definition of "throwing" projectiles and explosives? May an aeronaut carry a charge in the balloon, descend at a given spot, and plant it, with a time fuse attached? If so, may he, instead of descending himself, lower it to the ground by means of a rope? Then again, does this refer to small balloons carrying only a charge of explosives without a man? If so, does it apply to a small flying machine? Then where does the difference between a flying machine and a rocket come in? No, let us rather encourage this all-powerful aerial warfare, and we should be much more likely to approach the era of universal peace.

The Theory of Balloon Ascent. — Dr. Hergesell, of Strassburg, has contributed to the *Illustrated Aeronautical Magazine* (No. 4, *Jahrgang* 1899) a mathematical investigation of the theoretical vertical movements of a free balloon. The subject engaged the attention of Mr. J. Glaisher in the *Encyclopædia Britannica*, and is of considerable interest for scientific balloon navigation. The first case considered is that of the ascent of an imperfectly inflated balloon, and the formulæ give the velocity attained in a stratum of air of a definite density, *i.e.* at a definite altitude, and the time required in reaching this stratum. In the case of a perfectly inflated balloon, the investigation shows that the maximum height that can be attained depends entirely upon the lifting power, and that it is independent of the velocity of ascent, and of the resistance of the air. In the case of the descent of a balloon, it is shown that the velocity of the fall does not continually increase, as is often stated, but, on the contrary, decreases, and that there is no danger in allowing the balloon to descend from a great altitude without throwing out ballast, as the velocity of the descent decreases according to the greater height from which the descent is made. —*Nature.*

More Cross-Channel Balloon Trips.— On July 29th, Mr. Percival Spencer, accompanied by Mr. Pollock, started at 2.30 from the Crystal Palace. At 5.3 p.m., the balloon, at a height of 7,000 ft., passed out to sea near Hastings. By half-past seven the ballast was all exhausted, and shortly after the anchor was cut away and thrown out. The balloon then ascended to 12,000 ft., and at last, after 8 p.m., the French coast was reached, and a descent made between Dieppe and Treport.

On Aug. 15th, Mr. Percival Spencer made another ascent, and again crossed the Channel from Dover. It had been proposed to make the ascent the day before, before the members of the British Association, but the elements were not favourable, so early next morning Mr. Spencer and a companion ascended. Starting with a favourable N.N.W. wind, the balloon soon changed its course to the eastward, but after 2½ hours descended safely near Dunkirk, the distance being about 23 miles.

Kites for Meteorology.—At the recent meeting of the British Association at Dover, Mr. A. L. Rotch gave an interesting account of the work done at the Blue Hill Observatory during the last year. The average heights of the 10 kite ascents made during the first four months of 1899 was 7,680 ft. The maximum height was attained on Feb. 28th with an altitude of 12,440 ft. above the sea. The Hargrave kite with curved surfaces was found to be the most satisfactory form, owing to its simpler construction.

M. Teisserenc de Bort has been using kites regularly during the last year at the meteorological observatory at Trappes, several very high flights have been made, surpassing even those at Blue Hill, the greatest, made in August, having attained 14,107 ft.

Aeronauts versus Cyclists.—A curious competition, in which balloonists and cyclists participated, took place at Paris on 10th July. Four balloons, each carrying a cyclist with his machine, started from the Tuileries Gardens at five o'clock last night, their object being to descend at some distant point where the aeronaut could pack up his balloon and the cyclist despatch a telegram before being captured by their pursuers mounted on bicycles and motor cycles. The pursuers had an hour's start, taking their direction from a number of small pilot balloons, and they succeeded in capturing one of the aeronauts and his bicyclist near Ablon. M. Santos-Dumont, however, descended at Corbeil and escaped.

Important Observations have been made recently by Dr. J. Tuma, from balloons, for the purpose of obtaining measurements of the distribution of atmospheric electricity in clear weather, and of determining whether the balloon itself receives electrical discharges. The latter point is one of considerable interest,

in view of the burning of several balloons lately while up in the air. Out of seven ascents all the observations show that the positive potential decreases with increasing height, and is, therefore, apparently accumulated in the lower strata of the atmosphere. During the last four ascents Dr. Tuma was unable to find that the balloons were electrically charged.

Obituary.

M. Gaston Tissandier.

Gaston Tissandier, the famous balloonist and scientific writer, has just died, after a long illness, in his fifty-sixth year. The deceased aeronaut was born in Paris, and after having studied chemistry and physics with energy he took to ballooning with his brother Albert. They made nearly fifty ascents together, four being effected during the siege of Paris by the Germans. They were then attached as balloonists to the army of the Loire. In 1875 the deceased made the famous ascent in the Zenith balloon, which led to the deaths of his two companions, Croce Spinelli and Sivel. They went up a tremendous distance, 8,600 metres according to French reckoning, and Gaston Tissandier showed a marvellous resisting power on the occasion. This fatality did not check his ardour, for he soon afterwards made further ascents with his brother. They notably tried an electric navigable balloon about sixteen years since, and obtained thereby some useful results. M. Gaston Tissandier wrote many important scientific treatises in his time, and was a diligent contributor to reviews on chemical, meteorological, and aeronautic subjects. He and his brother also founded "Nature," a most useful periodical for all who are interested in the marvels of sea, sky, and land. One of his latest books was the "Martyrs of Science," and he has left behind some manuscripts which are of great scientific import and value.

Recent Publications.

"On Soaring Flight," by E. C. Huffaker, is a pamphlet published by the Smithsonian Institute. An introduction by Prof. Langley explains its contents. Of the two general methods of flight, the first, by the direct exercise of mechanical power, in which "there is nothing, considered as a mechanical contrivance, in apparent contradiction to known principles." Whereas the second, in which "birds can fly without flapping the wings, and are able to glide over the landscape on nearly motionless pinions, has never yet been completely accounted for," and this forms the special subject of the article.

In considering the various different methods by which this might be accomplished, Prof. Langley, dismissing the palpably absurd theories of the specific gravity of the bird being much lighter than air, or that of being sustained by wind on the principle of kites, speaks of ascending currents of air, which cannot be universally present, since "what goes up must come down." Two strata of air moving at different velocities might account for the mechanical possibility. So might the many undulations and eddies which may be found in the air. Still none of these explanations seem satisfactory, and adds, "we seem, then, to have exhausted every suggestion, and yet the soaring bird still soars and remains sustained in mid-air almost without an effort."

The theory now advanced by Mr. Huffaker may be shortly described as follows. The surface of the earth absorbing a certain amount of heat from the sun, warms the strata of air immediately above it. For various reasons this warm air does not immediately rise, but hangs like a mist near the surface of the earth. When, however, any local disturbance takes place, a column of the air is able to rise through the cooler strata, a "chimney" is formed, up which the warm air can rush with a velocity sufficient to carry up small articles, such as the sand column seen in the desert, or light strands of silk, as tried by the author. The suggestion is that a large bird by flying around flapping his wings is able to form such an upward moving column of air, which, once formed, is able to carry up any soaring birds which come to that spot, and thus they are able to spirally ascend to a considerable height, and then soar away to their destination.

This theory, novel as it may be, and correct in mechanical theory, seems, however, to be a little wanting. Such ascending currents—if they exist—can but be of the lightest description, and it seems scarcely possible to believe they could be sufficiently powerful to lift a heavy bird to a great height. Even the author owns the difficulty of the problem, and adds, what is very true, "some sort of solution is

Digitized by Google

desirable, if only to give direction to our investigations."

"LES MOTEURS LEGERS APPLICABLE A L'INDUSTRIE, AUX CYCLES ET AUTOMOBILES, A L'AERONAUTIQUE, L'AVIATION, &c." H. de Graffigny. 8vo, 332 pp. Paris: E. Bernard.

The title of this work sufficiently indicates the nature of its contents, giving theoretical and practical information chiefly about steam, petroleum, and electric engines, but also referring to other kinds. In comparing the relative weights of engines, with water, fuel, acids, &c., for one hour's consumption, the following interesting figures are given:—

	For a small Engine of about 1 H.P.	For larger Engines over 20 H.P.
Steam	100 kilo. per h.p.	40 kilo. per h.p.
Oil	20 ,, ,,	15 ,, ,,
Electricity	35 ,, ,,	25 ,, ,,

The oil engine is therefore considered altogether the lightest motive force.

"ETUDE SUR LA NAVIGATION AERIENNE." P. Girardville, Captain of Artillery. 30 pp., 10 figs. Paris: Berger-Levrault & Co.; 1899. Is a complete little résumé of the subject, dealing with navigable balloons, aeroplanes, and the flight of birds.

Foreign Aeronautical Periodicals.

L'AERONAUTE (Paris).

July.—Congrès International de 1900, with report of the Secretary of the Permanent Commission of Aeronautics, setting forth the programme of matters to be discussed at the various meetings.—Proceedings of the Société de Navigation Aérienne.—Committee of Aerostation.—Closed Car for Sounding Balloons (M. J. Paloux).—Ader's Apparatus, further details, stating it is to be exhibited at the Exhibition next year.

August.—Circular about the International Congress of Aeronautics of 1900. No date is yet fixed for its assembly.—The Aeronautical Exhibition at Munich. There are twenty exhibitors, including the Bavarian and the Prussian Aeronautic detachments.—Apparatus for determining the "gas retaining qualities of materials," by S. A. Andrée (with illustration).—"Thirteen Hours in a Balloon:" MM. Nicolleau, Capitaine Lebihan, and Feneuil ascended from Nantes at 5 p.m. on July 14th, and descended at 3 o'clock in the morning, near Baugé, whence they reascended.

September.—Gaston Tissandier: Life and portrait.—Meeting of the International Meteorological Committee.—Account of Ascents.—Women Aeronauts.—How a Balloon is made.

LA FRANCE AERIENNE (Paris).

1—15 *July.*—An Italian Soldier's Fall of 500 m.

15—31 *July.*—Aeronautics at the Exposition of 1900.—Ascent at Melun.

1—15 *August.*—Aeronautics and the accidents of work.—The 14th of July in the Provinces: Ascents at Mans, Lyons, and Epernay.—Necrology: The aeronaut Bernard.—Fantaisie Aerienne.

15—31 *August.*—Fantaisie (*continued*).—Necrology: Lt. Georges Houtelart.—Recollections of the Siege of Paris.

1—15 *September.*—Aeronautics from day to day.—Recollections of the Siege of Paris (*continued*).—Review of the Foreign Press: The *New York Herald* on M. de Bausset's ideas.

15—30 *September.*—An Ascent at Sartrouville.—Cycling and Military Ballooning.—Recollections of the Siege of Paris (*continued*).—Dirigible Balloon of M. Anastasin in Roumania (only an idea).

L'AEROPHILE (Paris).

September.—Portraits of Contemporary Aeronauts: M. E. Archdeacon (with portrait).—Results obtained by the Aid of Sounding Balloons.—From Munich to Vienna by Balloon.—The Latest Crossing of the Channel.—Death of M. Gaston Tissandier.—An Aerial Velocipede (illustrated): Mr. Carl Myers in United States. Balloon of 4,000 cubic feet, with a seven foot screw propeller worked by treddles.—Notes.

ZEITSCHRIFT FUR LUFTSCHIFFAHRT (Berlin).

June.—The Way to the Destination: A. Stentzel.—Studies in Aerodynamics: Josef Popper.—Notes.—The Shifting Equilibrium in Suspense.

July.—The Lifting Power of the Wind: F. Ritter.—V. Loessl's "Aerodynamical

Digitized by Google

State of Suspense of thin Planes"—On Buttenstedt's Theory of Flight.—Notes.

August.—On Military Ballooning: F. Hinterstoisser.—The Theory of the Kress Aeroplane.—Notes.—Reviews of Books.

ILLUSTRIRTE AERONAUTISCHE MITTHEILUNGEN (Strassburg).

July.—Frontispiece. Aeronautical Caricatures.—C. Kramp and Aeronautics (a book written in 1784).—Gliding Flight.—Arnold Samuelson (with photo. of model aeroplane).—Finding the Position of Sounding Balloons: W. de Fonvielle.—The Influence of Wind Pressure on the Rope of Captive Balloons.—Induction and Deduction in Aeronautics.—Official Account of the U.S. War Ballooning in Cuba (in English).—Buttenstedt and the Flying Problem.—Scientific Kite Flying in America: Warren H. Smith (in English).—Notes.—Myer's Sky Cycle, &c.—Proceedings of Societies—Patents.

Notable Articles.

June, *Cosmopolitan.*—"Progress in Air Ships." Illustrated description of Danilevski's and Santos-Dumont's.

July 10. *Daily Mail.*—"A Runaway Balloon." Ascent at Bradford.

10. *Bradford Observer.*—"Exciting Balloon Voyage."

14. *English Mechanic.*—"Flying Craft made Perfect." Prof. Langley's Machine (?) (*vide* "Notes").

14. *The Church Family Newspaper.*—"Up in a Balloon." Interview with Messrs. Spencer.

15. *Speaker.*—"The Possibilities of Flight."

15. *Field.*—"Long Distance Ballooning." Reprinted in this Journal (*vide* p. 78).

27. *Daily News.*—"Mr. Maskelyne's Wireless Telegraphy," in Conjunction with Mr. Bacon's Balloon Ascent.

29. *Daily News Weekly.*—"Prof. Langley's Aerodrome." Fully but incorrectly described.

31. *Daily News.*—"Balloon Voyage Across the Channel." Personal narrative by Mr. Spencer.

Aug. *Strand Magazine.*—"Over the Alps in a Balloon." (Illustrated.)

4. *Militar Zeitung* (Vienna).—"Military Ballooning."

13. *Manchester Umpire.*—"Ships of the Air—In a Balloon Factory." An interesting account of Messrs. Spencer's establishment.

21. *Daily Telegraph.*—"Up in a Balloon." Account of an ascent from the Crystal Palace.

Sept. 2. *Invention.*—"Balloons." G. TOPTS.

2. *Daily News Weekly.*—"A Balloonist's Adventures." Relates to M. Gaudron.

16. *Revue Scientifique.*—"Physique du Globe." Contains many interesting facts concerning the upper atmosphere gained by recent balloon and kite experiments.

16. *Illustrated Sporting and Dramatic News.*—"Ballooning." General account.

27. *Sketch.*—"Balloon Photography." Illustrated with four good birdseye pictures.

During the three months the *English Mechanic* has published a running correspondence on "Flying Craft," &c. Though a great deal has been written, there is little that is new, or of special interest in the correspondence.

Applications for Patents.

(*July, August, September*, 1899.)

14,615. July 15. HEINRICH BAUER, London. **Improvements in or Relating to Balloons or Aerial Machines.** (*Complete.*)

14,802. July 18. GUSTAV LOEPER, London. **Improvements in Navigable Balloons.** (*Complete.*)

14,958. July 20. ROBERT J. STANLEY, Cardiff. **An Improved Mode of Aerial Navigation for Torpedoes and other Machines.**

15,673. August 1. G. V. DUSINA, Rome. **A Navigable Air Ship.**

15,811. August 2. L. W. BROADWELL, Clapham. **Improvements in Flying Machines.**

15,877. August 3. EDWARD FENN JONES, Blackheath. **Screw Propeller for Regulating the Ascent and Descent of Balloons.**

16,840. August 19. H. W. C. Cox and C. F. LEIGHTON, London. **An Apparatus for Im-**

Digitized by Google

provements in Steering and Guiding Boats, Torpedoes, Balloons, and other Floating Vessels.

17,611. August 31. BURTON BROWN, Burnley. Improvements in Appliances for Affecting Aerial Navigation.

17,760. September 2. THOMAS MOY, London. Improvements in or Relating to the Propulsion of Aerial Vessels.

17,913. September 5. ANATASIA BAUMANN Liverpool. Water and Air Ship. (*Complete.*)

17,977. September 6. W. G. WALKER, London. Improvements in Aerial Screw Steamers or Flying Machines.

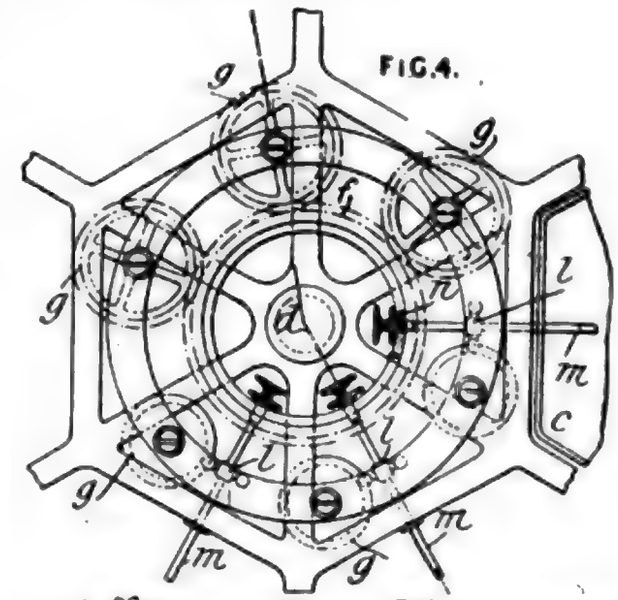
Patents Published.

Nos. 304, 557, 2,986, 3,515, 3,922, 4,257, 4,258, 4,642, 5,490, 7,214, 9,295, 9,875, are abandoned.

10,162. Balloons as Lifts or Elevators in Tall Towers.

11,914. May 25. Navigable Balloons. ZARSKI, E., 68, Boulevard de la Liberté, Lille, Nord, France.

The machine is propelled by feathering paddles *c* revolving on a shaft on a level with the axis of the aerostat *b*. The vanes *c* are carried on shafts *m*, and are turned through a quarter of a revolution each time they come into and go out of action by cams *k*, Fig. 6, on shafts *h* which engage wheels *l* on the shafts *m*. The wheels *l* have spherical bowls on their teeth, and the shafts *h* carry wheels which gear with a fixed wheel *f* of double their diameter, so that they make two revolutions about their axes to one of the shaft *d*. The end thrust of the shafts *m* is taken on ball bearings or pivots *n*. The steering-ropes *t* connected with the rudder *p* pass through the balloon and have conical



collapsable sleeves *u* attached to them at one end and to the balloon at the other, to prevent leakage. The axis of the paddles may be turned relatively to the axis of the balloon to steer the machine.

United States Patents.

Nil.

French Patents.

285,756. GENTIL. Aerostat Dirigeable.

286,389. PRAT. Nouveau Balloon Dirigeable.

286,541. March 6. DE LA TOUCHE. Ballons Jumeaux Captifs Economiques et Sans Danger.

Digitized by Google

-0.5
2 45

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4 191

THE AERONAUTICAL JOURNAL



No. 13. JANUARY, 1900. VOL. IV.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	95
THE DEPARTURE OF MAJOR BADEN-POWELL FOR SOUTH AFRICA	95
THE BALLOON AT THE FRONT	96
DR. K. DANILEWSKY'S AERIAL EXPERIMENTS (*Illustrated*)	98
THE VALVELESS BALLOON VOYAGE. BY A FELLOW OF THE ROYAL METEOROLOGICAL SOCIETY	99
SCIENTIFIC RESEARCH IN AERONAUTICAL PROBLEMS. BY H. A. B.	101
PHOTOGRAPHY FROM BALLOONS. BY PERCEVAL SPENCER (*Illustrated*) ..	103
THE FORTHCOMING INTERNATIONAL AERONAUTICAL CONGRESS. BY ERIC STUART BRUCE, M.A., OXON.	105
NOTES:—LORD RAYLEIGH ON "FLIGHT"—A POSSIBLE USE OF MONTGOLFIER BALLOONS IN WAR—THE APPLICATION OF WIRELESS TELEGRAPHY TO BALLOONS—THE DUKE OF ARGYLL ON THE ZEPPELIN AIR-SHIP. ..	107
OBITUARY: MR. HENRY COXWELL	109
FOREIGN AERONAUTICAL PERIODICALS	109
NOTABLE ARTICLES	109
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED—FOREIGN PATENTS, &C.	110

LONDON:
PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

PUBLISHED BY THE AERONAUTICAL SOCIETY.

Reports of the Aeronautical Society - - - - - - - - of Great Britain, 1866-1893.

21 VOLUMES - - - - 1s. EACH.

THE NAVIGATION OF THE AIR.

By A. McCALLUM.

Reprinted from the *Glasgow Herald* - - - - - - - - - - **PRICE 6d.**

To be obtained from the Hon. Secretary, 8, St. George's Place, S.W.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JANUARY, 1900.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on December 5th, when the following gentlemen were elected Members of the Society :—

Mr. CHARLES LYELL.

Mr. WILLIAM ALFRED SOUTH.

The following lady was elected an Honorary Member of the Society :—

MISS ELLA PILCHER.

RESOLVED—

The Council of the Aeronautical Society of Great Britain take this opportunity of recording their sense of the valuable services contributed by the late Mr. Pilcher to the subject of aeronautics, and feel the great loss which the Society has sustained by his untimely death in carrying out his practical aerial experiment.

The Council also desires to express their deep sympathy with Miss Pilcher, an Honorary Member of the Society, in her irreparable loss.

The Council of the Aeronautical Society, at their meeting to-day, take this the earliest opportunity since the departure of Major B. F. S. Baden-Powell on service in South Africa to record their best thanks to him for the great interest he has shown in the affairs of the Society, and for the very efficient manner in which he has conducted the duties of Honorary Secretary since the decease of the late Mr. W. Breary.

The Council look forward to giving Major Baden-Powell a hearty welcome on his return to England.

ERIC STUART BRUCE,
Honorary Secretary, pro tem.

The Departure of Major Baden-Powell.

On the occasion of the departure of the Scots Guards from Chelsea Barracks for South Africa, on the morning of Saturday, October 21st, a deputation from the Aeronautical Society of Great Britain, including Sir William Crookes, F.R.S., Mr. Hiram Maxim, and Mr. Eric Stuart Bruce, attended to wish Major Baden-Powell a hearty farewell, and a safe and a speedy return. Hopes were expressed that the present war would give opportunities for the use of the War Kite, with which his name has been so prominently associated. Many letters and telegrams were received by the Deputation from those who were unable to be present, and amongst those who thus joined in the good wishes of the Society were Major H. C. Roberts, Mr. E. A. Barry, Mr. E. P. Frost, J.P., Dr. Leslie Earle, and Major Fullerton, R.E.

During the absence of Major Baden-Powell in South Africa, Mr. Eric Stuart Bruce will act as Honorary Secretary to the Aeronautical Society, and will edit the "Aeronautical Journal." All communications should be addressed to him at 19, Campden House Road, Kensington, London, W., until Major Baden-Powell's return.

Owing to the widespread interest taken in the aerial experiments of the late Mr. Percy Pilcher, the Aeronautical Society has arranged with the management of the Crystal Palace for the exhibition of his flying machines, which will be shortly on view.

Major Baden-Powell, in a letter to Mr. Eric Stuart Bruce, dated Modder River, December 14th, sends the following interesting description of the use of the British War Balloons in South Africa :—"There is a balloon section here (and another at Natal) under Captain Jones, R.E., with Lieut. Grubb

Digitized by Google

and Earle. An ascent was made at the attack on Magersfontein on December 11th, and the balloon was up all day, giving much valuable information as to the effect of shell fire, etc. On 15th the balloon was towed out to take part in a reconnaissance, but a very high wind prevailed, which rendered an ascent impossible. While being held down on the ground an extra strong gust of wind caused a big rent, by which all the gas was lost."

The Balloon at the Front.

There could be no better opportunity for displaying the value of the balloon as an adjunct to war than the fierce campaign now in progress in South Africa. Its use in one position alone—that of Ladysmith—has justified the expenditure that our Government has sanctioned in forming what is undoubtedly the finest military balloon equipment in the world, so far as the observation balloon is concerned. To reconnoitre the enemy, is, indeed, the principal use to which balloons are at present applied in the British Army, and critics will be inclined to wonder why so many other uses of balloons of war are apparently neglected by the aeronauts at the front. Why, it is asked, have no experiments been in progress during these years of peace towards attaining an air craft that is navigable, or so far navigable as to be able to proceed against such light winds as have Captains Krebs and Renard in their navigable balloon "La France." This balloon is said to have made a return journey to the place whence it started five times out of seven ascents. Though the successful experiments were only accomplished on practically calm days, in war time a calm day might be utilized for carrying despatches or taking photographs in such a balloon.

Again, the usefulness of electric balloon signalling in such a hilly country as the Transvaal is obvious, and since the system which has been described in this journal found favour with the Government experts who purchased apparatus for its working, it is being asked why the system which, by its altitude, makes visual signalling independent of the configuration of the country is not being widely used in the hour of urgent need by the signalling service?

But we have not far to look for the reasons for any omissions in extending the balloon service beyond the use of reconnoitring. It must be remembered that the balloon section of the British Army, as it exists to-day, is of very modern date, so modern that a comparatively few years ago balloons in our army were only represented by a balloon committee, who were much hampered in the slenderness of the grants they received for carrying out their expensive experiments. During the years 1885 and 1886 so much scepticism as to their utility existed that fears were entertained as to the ultimate position of the British war balloon. But the power of individuality saved the situation. Fortunately for the balloonists, the Inspector General of Fortifications at that time was General Sir Andrew Clarke. It was his keensightedness that foresaw the day when Great Britain would need her balloon eye, it was his enthusiasm that won for the aerial experiments fairer consideration and ampler funds, until repeated experiments on field days and in autumn manœuvres gradually dispelled both prejudice and scepticism, and secured for the balloon a decisive recognition. When more adequate grants first came to hand, it was expedient to partly expend them on mere necessaries. for instance, to replace the sheds in which the balloons had been made and stored at Chatham by the factory which has now been erected at Aldershot. Colonel Templer, the superintendent of the balloon factory and instructor in army ballooning, in concentrating his first efforts on one important branch of military ballooning and making that as perfect as possible under the difficulties with which he had to contend, has displayed his wisdom, though he doubtlessly will not hesitate in the future to extend his efforts to those other branches of ballooning where his exceptional talents are also wanted.

Perhaps the strongest point concerning the National Balloon Equipment is the material out of which the balloons are constructed, viz., goldbeater's skin. The adoption of this material was nothing short of a stroke of genius on the part of Colonel Templer and Major Elsdale. For some time past balloons had been made of this material, and sold in abundance by opticians, but to the above-mentioned officers belong the honour of making large balloons to carry passengers of this material, and securing the services of the workman who had for years made the toy balloons.

Balloons made of goldbeater's skin have the advantage of retaining the gas much

Digitized by Google

longer than balloons made of varnished silk or cambric, for there is no varnish in the market that is successful in retaining the subtle hydrogen or near the mark in accomplishing this. There is a tradition on the Continent that in the early days of ballooning there was a fairly gas proof varnish, and that the secret was lost. If so the chemist may do a real service to aeronautics in rediscovering it.

Another advantage of goldbeater's skin balloons is that they do not easily heat, while the ordinary varnished balloons are notorious for heating. The former can, therefore, be stowed away with safety. In the issue of this journal for October, 1899, extracts from the official report of Lieut.-Colonel J. E. Maxfield, U.S. Volunteer Signal Corps, to the chief signal officer U.S.A., are quoted under the title, "War Ballooning in Cuba," page 83. It is related how the United States balloon corps, when they wanted to use the old balloon after the landing of the troops at Daiquiri, found that the extreme heat had softened the varnish so as to cause the parts of the envelope to stick together, with the result of "scorching," which rotted the balloon. This "scorching" is almost an every-day occurrence with balloons made of varnished silk or cambric if they are packed up without attention. Their manipulation requires the utmost care, which in transport cannot always be afforded. Even during manufacture an ordinary varnished balloon may burst into flame if the weather is fairly hot and the ventilation of the factory insufficient. The writer has seen the partial destruction of a balloon of 100,000 cubic feet capacity in a few moments during its manufacture on a warm spring day in too confined a place.

A third, but all-important advantage of the goldbeater's skin balloon is its extreme lightness, compared with balloons made of other materials. Fill a small goldbeater's skin balloon of a few inches diameter with ordinary coal gas, and it will ascend; fill a cambric balloon of the same size with the gas, and it does not move upward; make the latter ten times and more the size, and it remains a dead weight. Thus the use of goldbeater's skin secures a much smaller sized balloon for a given lifting power than varnished cambric and silk. In reference to the report above quoted, Lieut.-Col. Maxfield says at the conclusion of it, that balloons employed in military reconnaissance should be of at the least 18,000 cubic feet capacity. But our British war balloons can be only of 10,000 cubic feet capacity, and thoroughly efficient. The reduction in the size of the balloon by the use of goldbeater's skin does not only reduce the size of the balloon, but also the weight of the balloon equipment. When cylinders of compressed gas are taken out to the scene of operations to fill the balloons, the balloon of 10,000 cubic feet capacity would only require about eighty-four steel tubes to fill it, each of these being about 8 feet long, 5⅜ inch diameter, weighing some 70 lbs., and containing 120 cubic feet of hydrogen. If, on the other hand, a balloon of 18,000 cubic feet capacity is used as is officially recommended in the United States, the number of tubes required would be not so very far short of double the number.

A fourth advantage of the goldbeater's skin balloon is strength. At first sight the material would seem too fragile, for most persons are familiar with goldbeater's skin as the thin transparent plaster which is used for a cut finger. But the desideratum of strength can be obtained by combining layers on layers of the substance to any desired thickness by an ingenious process designed by Colonel Templer and Major Elsdale. The balloon exhibited so long in the War Department of the inventions exhibition at South Kensington was a tough and robust specimen of a skin balloon, and it displayed its power of retention of hydrogen, remaining day after day untouched without its shape being lost. It was only at long intervals that the sapper brought his replenishing tubes. But goldbeater's skin balloons are expensive. They may be the balloon luxury of a Government, though almost beyond the reach of the ordinary aeronaut.

The system adopted by our Government of compressing the gas in steel cylinders, and taking them to the place of operation, is undoubtedly handier than filling the balloon direct from the manufacturer's apparatus, and in the former way it can be done with far greater speed. The one disadvantage of the steel tube is the chance that one may prove an explosive bomb, being almost as destructive as lyddite if more than the right quantity of gas is compressed into the cylinder. An ingenious inventor has, however, lately taken out a patent for obviating all risks of explosion, and by the use of the device it will be impossible to compress more than the right quantity into the cylinder. Concerning the

Digitized by Google

manufacture of hydrogen, experiments have been carried out at Aldershot lately with the electrolysis method of procuring pure hydrogen on a large scale, the apparatus having been designed by Messrs. Siemens. The special advantage of the electrolytic method is the purity of the hydrogen, and consequently greater lifting power for a given quantity.

The captive observation balloon has during the siege of Ladysmith frequently ascended, and its usefulness has been reported in the columns of the daily papers. It has been pointed out by the "Graphic" correspondent that the translucent South African atmosphere peculiarly lends itself to balloon observation, that in manœuvres in England the range of a balloon's effective vision at a height of 1,000 feet is not more than some seven or eight miles, whereas in South Africa it is ten or twelve miles. By means of the observations from the car of the balloon at Ladysmith the Boer guns have been located, and our artillery fire has been made decisive and accurate. A little to the right or a little to the left is often the message telephoned down to earth from the officer in his elevated position, and that little has made all the difference. If our Naval guns have saved Ladysmith they owe much to the balloon.

The usefulness of the balloons has been acknowledged by the enemy. According to the "Morning Post," of December 16th, an official despatch from Commandant Cronje says "The British are greatly assisted by balloons."

As to the chances of a balloon being destroyed by the enemy, practical experiments at Lydd have shown that a balloon may be almost rifled with bullets in its lower portion, and yet remain in the air owing to the upward pressure of the hydrogen gas. Artillery fire is more formidable, but this is not very appalling to the occupants of the car, as the "Graphic" correspondent states in the experiments at Lydd a 13-pounder field gun was turned on to the balloon when it was 1,000 feet high, at a range of 4,000 yards. The balloon was not struck till the seventeenth shot. Balloon experts consider a balloon quite safe if sent up three miles from artillery. In case of accident, however, it would seem desirable that balloon scouts should be well practised in the skilful use of the parachute in case they may have by its means to precipitate themselves to earth.

Dr. K. Danilewsky's Aerial Experiments.

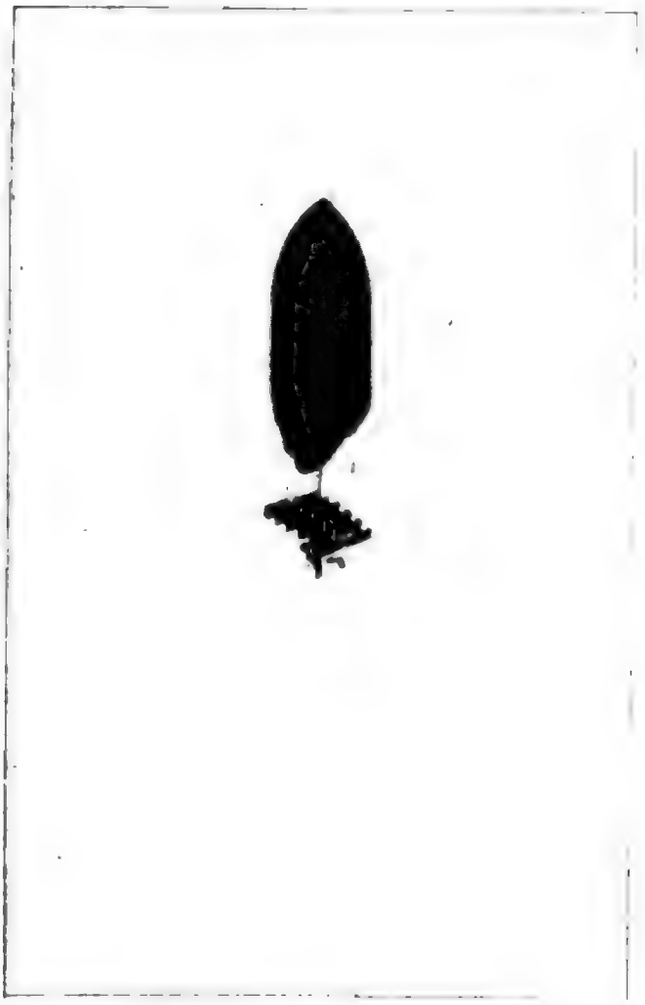
At the Aeronautical Congress at the last Paris Exhibition, M. Aimé urged that that improvement in regulating the vertical motion of balloons was the first necessity for aerial navigation. Few inventors have taken heed of his useful suggestion, though many efforts have been concentrated on the control of the horizontal movements of



aerial machines. In the issue of this journal, published January, 1899, some details concerning Dr. Danilewsky's experiments appeared (page 6). By his apparatus he claimed to have so far improved the vertical motion of the balloon that twenty-five ascents were made in an hour and a half to the height of 280 feet. He also claimed being able to control the horizontal movements of his machine in calm weather. Dr. Danielewsky has sent several photographs of his improved direct-

Digitized by Google

ible flying machine to the "Aeronautical Journal," one of these is reproduced. Further details of Dr. Danilewsky's latest experi-



ments will be awaited with interest, and it is hoped that we may be able to furnish them in an early number of this journal.

The Valveless Balloon Voyage.

By a Fellow of the Royal Meteorological Society.

When the astronomers next announce an exceptionally brilliant display of the Leonids, for the sake of the balloonists who make elaborate and costly preparations, it is to be hoped they will be more accurate in their calculations. The spectacle of seven shooting stars is in itself scarcely worth such a risk to life and limb as the Rev. J. M. Bacon experienced in his ascent in search of the meteors. But the scientific observer gains fresh experience from every journey he makes into the upper strata of the atmosphere, and probably Mr. Bacon has accumulated a sufficient number of facts to repay him for the suspense and discomfort endured.

The ascent was made under exceptional circumstances. Mr. Bacon, his courageous daughter, and Mr. Stanley Spencer, entrusted themselves to a valveless balloon; for if we accept the term valve in its legitimate sense, the arrangement provided for ripping open the top of the balloon and letting the gas out once and for all cannot be called a valve. It is easy to criticise apparently rash proceedings in balloon management, but the aeronaut in charge had a difficult task appointed him when he was instructed to have a balloon moored and ready to start at any moment during two consecutive nights, and it was to prevent leakage and enable the balloon to be adequately full of gas at a given moment that the ordinary valve was dispensed with.

Mr. Bacon has supplied a graphic account of his experiences in the "Times," that newspaper having commissioned him to make the ascent. He thus describes the start:—"The sky remaining overcast we followed the advice given us, and shortly after 4 a.m. took our places in the car, and amid a cheer from many hundred onlookers, quickly mounted to the region where a murky canopy hung overhead. This canopy, proved to consist of a dense wetting fog, 1,500 feet thick. In traversing it, the balloon, which had remained captive in the still warm air of a mild November night, became heavily charged with condensed vapour, and at the same time greatly chilled. The consequence was that it became necessary to discharge a great quantity of ballast to enable us to penetrate the cloud. Even then the balloon again and again sank back into the mist. Only at my earnest entreaty that we should keep well above in view of the stars, and contrary to his better judgment, Mr. Spencer continued to throw out ballast till no less than seven bags had been discharged in 20 minutes."

In planning his valveless balloon, the aeronaut had probably not anticipated this early sacrifice of ballast, which was sufficient to account for much of the subsequent history of the ascent, which was an object

Digitized by Google

lesson in the sensitiveness of a balloon to the temperatures it encounters.

Mr. Bacon vividly describes how, when day had dawned, and the first beams of sunlight warmed the gas, the balloon, which had appeared lifeless in the moisture-laden cloud, and on the verge of descending to earth, suddenly became inspired with a new life and ascensional force, and mounted up by leaps of 600 feet in every quarter of an hour, till by 9 o'clock it had reached an altitude of 6,000 feet, and was still rising. It is explained that to rip open the balloon at that elevation would have been madness, and that there was no alternative to drifting at the mercy of the currents in ignorance of the whereabouts of the balloon, whether its course was over land or sea. But the suspense of the situation did not blind the travellers to the grandeur of the spectacle that in the early morning spread beneath them. If they had been cheated of falling stars, they were partly compensated by the grandeur of the cloud phenomena! "Several thousand feet below us was spread out, bathed in the intensely bright sunlight, a cloud sea of exquisite beauty. Away to an infinitely distant horizon stretched rolling billows of snowy whiteness, broken up here and there into seeming ice fields with huge fantastic hummocks. Elsewhere domes and spires reared themselves about the general surface, or an isolated Matterhorn towered into space. In some quarters it was impossible to look without the conviction that we actually beheld the outline of lofty cliffs overhanging a none too distant sea."

This captivating narrative goes on to say how, as time went on and the gas expanded under the increasing heat of the sun, the balloon relentlessly continued its vertical course. We are told that at one moment the aneroid registered 9,000 feet, and then the balloon was moving upwards We are not, however, told what was the highest point reached in this remarkable ascent, a fact which would have been of great interest. The time records of altitude do not seem to have been completely kept, as Mr. Bacon mentions that at 12 o'clock the travellers were astonished to find that the balloon had dropped 2,000 feet. The reduction of lifting power was undoubtedly owing to the meeting of cold currents. It is thought that at the moment that the reduced height of 7,000 feet was noticed, the balloon was crossing the Bristol Channel. "Undoubtedly it was some cold current blowing up the estuary of the Severn that first gave the downward motion to the balloon. Moreover, the upper currents must from this point have greatly increased in speed, blowing stiffly up the sea reach, and eddying in wayward courses above the mountains of South Wales." In half an hour's time it was estimated that the balloon was not more than 1,000 feet above the cloud floor below, "now breaking here and there into little black bits, like snowfields beginning to thaw."

I have mentioned the absence of more detailed records of the altitudes attained to emphasize the intense value of minute observation and record in scientific balloon ascents. A table showing the direction of the aerial currents encountered, the temperature of the currents, the influence of the degree of temperature with the rising and falling of the aerial machine, would be a treasure for the meteorologist and physicist. In making these suggestions, I am not criticising the work of Mr. Bacon, for such a programme as above-mentioned could not be undertaken without the aid of many expensive instruments. Mr. Bacon bears the honour of having revived in this country the noblest use of the balloon as the instrument of scientific research. He and others who follow his example need the hearty support of associations and societies—nay, even more than this, they call for Government aid in providing the sinews of experiment in the shape of substantial grants.

Much must be risked when the advance of knowledge is at stake. In the past, when the British Association took an interest in scientific ballooning, a balloon car has been equipped with most costly apparatus, transforming it into a physical laboratory, with its varieties of thermometers, barometers, hygrometers, and chronometers, and on the descent the balloon came down with a shock that broke nearly every one. But the few scientific facts accumulated during the ascent by Mr. Glaisher were considered sufficient to compensate for the accidental destruction of the means of acquiring them, and before the next ascent the instruments were replaced. Meteorologists often wonder why the British Association left off its patronage of aerial research. Probably it had some good reasons for a temporary cessation of the work, but there are many good reasons why it should resume it. Of the meteorology of the upper

Digitized by Google

atmosphere we know as yet next to nothing, and the science of meteorology is almost entirely confined to what should be a subordinate branch, "Terrestrial Meteorology." But it is doubtless on the movements of the upper currents undisturbed by terrestrial influences that the laws which regulate weather changes largely depend, and the systematic study of these should add to our power of weather forecasts, which may in the future not be a matter of hours, or even days, but weeks and months.

But to return to Mr. Bacon's adventures. When the dissolving clouds were first revealing glimpses of those ruddy fields that betokened that the balloon was threading its way over the south-west corner of England, even now the balloon seemed hesitating whether or not it would descend. "Each downward plunge was eagerly watched, timed, and recorded, but each ended with a pause, and then a re-ascent. Our monster balloon was dying very hard by sheer slow leakage of gas only."

But at last it sank into a layer of cloud whose chilling influence did the work of compressing the gas, and taking the last life out of the unmanageable balloon. It is not mentioned whether Mr. Stanley Spencer found it necessary to rip open the top of the balloon. The ground was struck with violence, and in a remote corner of South Wales the gusts of wind blew the balloon against various obstacles with such force that Miss Bacon's forearm was broken, and Mr. Bacon's clothes were partly torn from him. At last the ballon caught in a half-grown oak, in which the anchor held, and here ended the journey.

One incident of this ascent is especially worthy of notice, as it records a successful communication with the earth from a height of two miles. While the balloon was drifting at the mercy of the aerial currents and their temperatures, the happy idea occurred to Miss Bacon of throwing down written messages of distress, and three dozen of such messages, folded up as three-cornered notes and marked important in red chalk went overboard. It might be thought that the chances of one of these coming to hand were remote, but future balloonists in distress may take comfort in the thought that one of these distress notes was actually picked up at Pontypridd, and that the person who held it would have carried out the suggestions for help it contained had he not learned in time that the balloon had descended before reaching the sea coast.

It has been claimed that this balloon voyage is a record for England as far as the actual time the balloonists were up in the air. This was ten hours, but this time has often been exceeded on the Continent, where the descent is not hurried for fear of the sea. News has, indeed, lately come to hand of the balloon voyage of Count de Saint Victor and M. Mallet. They travelled from Paris to Sweden in a balloon, and it is said the entire journey occupied 23 hours.

But according to the accounts published in the journal of the "Société Française de Navigation Aérienne," this record of 23 hours has now been beaten by Le Comte Henry de la Vaulx et Le Comte de Castillon de Saint Victor, in the balloon l'Aero Club. It is stated that these aeronauts remained in the air for 29 hours and five minutes. This is the longest known record in the whole world. Possibly unknown to the world, M. Andrée and his companions have made a longer one.

Scientific Research in Aeronautical Problems.

By H. A. B.

The bearing of pure scientific research on practical scientific developments has been demonstrated again and again; and interesting and valuable as are all aeronautical attempts, it is more than probable that the solution of flight and aerial navigation may be achieved after all by the physicist or the meteorologist. Just now, this thought is borne in on us by the physical experiments to determine the resistance of the air of M. L'Abbé Le Dantic and M. Canovetti, and by the publication of the annual bulletin of the Meteorological Commission of the Bouches du Rhône. There are some observations in this of the direction, frequency, and force of the wind made at the Marseilles Observatory at the height of 75 m. Such observations are preliminary steps to a meteorological knowledge of the conditions of the lower and upper atmospheres essential to the making of any seasonal maps of the winds; without such maps many practical aeronauts who look to utilising the wind forces for the purposes of motion consider aerial navigation doomed to remain empirical.

Digitized by Google

These Marseilles observations at the height of 75 m. are of the eight predominant winds, taken every 6 hours, from 7 in the morning till 10 at night; the force is noted for each degree that such a wind blew at such an hour, and is represented by 0 none, 1 weak, 2 moderate, 3 pretty strong, 4 strong, 5 very strong, 6 violent.

Monsieur Robert Guerin has communicated to "La France Aerienne" the interesting tables that resulted of the meteorological year 1897-98, and tables of the mean of frequency and force for the last 25 years, and the following table of the classing of the 8 winds from the 6 daily observations is from his paper.

The general predominence of the north-west and west winds is apparent; but the preliminary tables of the 6 observations, both for 1897-98 and the mean of the preceding 25 years, showed that at 10 in the evening the predominant wind was north-east, it was also the fairly predominant wind at 7 in the morning. This year's table, like those of some past years, shows a variation from the mean of 25 in the predominance of the north-east over the west wind.

	Meteorological Year. 1897-1898.		Mean of last 25 Years. 1874-1898.	
	Frequency.	Force.	Frequency.	Force.
N.W.	103·3	2·2	104·1	2·4
W.	52·2	1·4	63·6	1·4
N.E.	62·0	0·6	53·5	0·6
E.	38·8	1·2	45·6	1·3
S.W.	39·5	1·1	36·1	1·1
S.E.	35·7	1·5	35·1	1·7
S.	17·5	1·5	17·3	1·5
N.	13·3	1·4	6·4	1·6
No wind ..	2·7	„	3·5	„

It would be interesting to know what was the instrument used to measure the wind force? These instruments have received much attention in England at the hands of the Royal Meteorological Society, and their records teem with considerations of the merits of the various forms of wind velocity and wind pressure gauges, and anemometers. In Great Britain we are not entirely neglecting the compilation of wind records at heights, and these, with French records, pre-eminently on account of the height of the tower, the Eiffel tower work, will furnish invaluable data for the formation of the aeronautical wind-maps of the future.

A consideration of the work of MM. Le Dantic and Canovetti leads us away from meteorology to the experiments of the physicist. Their experiments were carried out in connection with the *Société d'Encouragement pour l'Industrie Nationale*, who, recognising the importance of a knowledge of the resistance of the air to moving bodies, offered a prize for experimental work in investigating "the reactions on a surface moving through the air under varying conditions as to form and velocity." "Nature" gives an illustrated account of the experiments done by MM. L'Abbe, Le Dantic, and Canovetti, drawn by G. H. Bryan from the papers they communicated to the bulletin of the Society, and from report on them by M. Barbet.

Few probably know the difficulties in the way of the determination of the weight of a cubic centimetre of absolutely pure water. But such exact determinations are the very essence of scientific advancement. An example of the value of the minutest calculations was evinced not very long ago by the classic researches of Lord Rayleigh, which led to the discovery of Argon. It was nearly as difficult for M. Le Dantic to get a large volume of air free from all currents, so as to obtain accuracy in his experiments, as it has been for others to weigh a cubic centimetre of pure water. In M. Le Dantic's experiments the feeblest air currents would have detracted from their accuracy. He therefore selected the chapel of the Conservatoire des Arts et Metiérs, which was a closed building sufficiently large for the walls not to affect the stream lines of the air flowing past the moving surface.

In his experiments the surface whose resistance has to be measured is caused to slide down a vertical wire which acts as a guide without affording perceptible friction. The weight and area of the surface is easily and accurately measured, and the time of its fall estimated with precision by an electric recording apparatus. M. Le Dantic found that 1 square surface, 1 metre square, moving with a velocity of 1 metre per second, experienced a resistance of 81 grammes. Experiments with surfaces of same area, but of different forms, viz., circular, square, and in the shape of a equilateral triangle show that the resistance of a surface of given area is proportional to the length of its contour. This latter appears to have been newly discovered in these experiments. For velocities varying within certain limits the law of proportionality of the

Digitized by Google

resistance to the square of the velocity is verified.

M. Canovetti's experiments were much more of the rough and ready type than those of M. Le Dantic. In his method the surfaces to be tested are suspended on a trolley which runs down an inclined copper wire, three millimetres in diameter and 370 metres in length, of which one end was fixed on the side of a hill, and the other on the level ground at its base. Owing to the wire hanging in a catenary, the difference of inclination parts of the course interfered with the accuracy of the experiments, the motion not being uniform. It is, however, rather remarkable that M. Canovetti's experiments do not show a greater discrepancy with M. Le Dantec's than they do. For instance, M. Canovetti obtains 90 grammes for the resistance of a rectangle, where M. Le Dantec finds 81. But in scientific investigation it is the next to nothing that is all important, and the greater accuracy of M. Le Dantic's experiments will compensate for the greater labour he expended on their preparation.

Photography from Balloons.

During the past season, I have taken aloft on several occasions a Frena camera which carries forty films on celluloid packed flat like a pack of cards, and have made "snap-shots" of the scenery over which the balloon has crossed. There is considerable difference between the results obtainable in different atmospheric conditions, but it is generally possible to obtain photographs when at less than 500 feet in height. Above this height a great deal depends upon the amount of haze on the earth. Sometimes even up to 10,000 feet a picture may be obtained, but often exposures made at this altitude and at other heights down to a thousand feet are not successful, owing to the veil which prevents the actinic power of the reflected light from the earth penetrating through to the sensitive film in the camera. As examples, I append a picture taken at Wolverhampton at a height of 250 feet. This shows the immense crowd around the balloon enclosure, with upturned faces gazing at the de-



Digitized by Google





Digitized by Google

parting balloon. The next picture shows the City of York with the minster, old wall, and houses taken from an altitude of 500 feet. The third picture is looking down on the Crystal Palace from 1,000 feet high, and the last shows the town of Hastings, with the sea and piers forming a harbour, taken from a height of 5000 feet on the occasion of the cross-Channel trip I made in company with



Mr. Pollock on July 29, 1899. During next season I shall hope to obtain further data of this most interesting branch of aëronautics, and perhaps the assistance of friends with cameras to accompany me on balloon voyages and thus obtain photographic records of our trips.

PERCIVAL SPENCER.

The Forthcoming International Aeronautical Congress.

The Executive Committee of the Paris International Aeronautical Congress of 1900 has sent a most cordial invitation to the Aeronautical Savants of Great Britain to take part in its proceedings.

The Congress will be held at the Meudon Observatory. The date does not appear to be finally fixed, as efforts are being made to hold it as near as possible to the dates of the Meteorological Congress in consideration of the close relationship which exists between Aeronautics and Meteorology. The Executive Committee includes many distinguished scientists. The president is M. Janssen, the director of the Meudon Observatory. The general secretary is M. Triboulet, the secretary of the Société Française de Navigation Aerienne and editor of the French Aeronautical Journal. Amongst other members are M. Aimé, the secretary of the Paris Aero Club, Dr. Angot, M. Arson, Professor Baille, M. Caillettet, M. Cornu, M. De Fonvielle, M. L'Hoste, and M. Mascart; a list o names which show the high place aeronautica science has attained in the country which is the birthplace of the balloon, and ever been foremost in its use and development.

Those who wish to take part in this important Congress should communicate with the secretary, M. Triboulet, 10, Rue de la Pépinière, Paris.

The following are some of the subject proposed for discussion:—

Digitized by Google

1. Aerial Navigation.

Ballons libres—Stabilité du ballon dans la verticale. Perfectionnement des moyens d'arrêt et des organes de Manœuvre en L'air. Perfectionnements à apporter à la technique de la construction de ces engins (étoffes, vernis, filets, &c.). Contribution à l'étude théorique des ballons libres, tant au point de vue statique qu 'au point de vue dynamique (déplacements verticaux, résistance de L'air, vitesse des mouvements) &c.

Ballons Captifs.—Mode de suspension et d'attache du câble. Appareils mécaniques d'ascension et de descente. Moyeau de communication avec la terre ; emploi éventuel de la télégraphie et de la téléphonie sans fils. Protection des ballons captifs contre la foudre. Choix d' une forme rationnelle pour la ballons captifs. Contribution à l'étude théorique de ces ballons.

Ballons Dérigeables.—Moteur legers. Résistance des carénes aériennes ; étude expérimentales. Form rationnelle à donner aux ballons dirigeables. Stabilité de la route. Stabilité longitudinale. Moyens de manœuvre dans le verticale. Gouvernails presentation de projéts, d'études théoriques et d'expériences se rattachant à cet important sujet.

Aviation.—Etudes théoriques et experimentales sur les appareils de sustentation, celle-ci étant dépendante on indépendante du mouvement horizontal du navire aerien. Stabilité des appareils d' aviation et notamment des aéroplanes. Etude historique de cette question encore si nouvelle.

2. The Scientific Applications of Aeronautics

En astronomie.—L'observation de étoiles filantes. La mesure de la radiation solaire, &c.

En Météorologie. — L'étude thermique, chimique, actionométrique, spectroscopic et hygrométrique de l'atmosphere, l'observation des nuages et des divers, l'étude des phénoménes électrique, des vents des hautes regions, &c. La météorologie ne sera une science complète que lorsque aura été possible de l'étudier en ballon d'une façon régulière dans toute l'entendeur globe.

Les cerfs-volants, qui ont été l'objet récemment de trés grands perfectionnements et qui atteignent aujourd'hui des hauteurs de plus de 3,000 metres, pervent de leur côté apporter une contribution trés efficace aux diverses études météorologiques.

Les sondages aériens par ballons non montes fourniront egalement des renseignements précieux quand ils serouf exécutés par séries régulières et organisées après entente entre les divers pays civilises.

En phyiologie. Determiner les caractères graphiques du pouls et de la pulsation du cœur et les comparer à ceux qu'on à observés à des altitudes semblables dans les ascensions de montagnes. Mesurer les changements du périmètre de l'abdomen à déverses hauteurs. Déterminer les changements de fréquence de le respiration et la durée relative de ces deux phases. Mesurer la force musculaire avec la dynamomètre, &c.

It will be noticed that some of the subjects proposed for the congress are of the highest importance, and that many are of a very practical nature. They indicate how necessary it is for the improvement of the balloon and for attainment of the knowledge of the principles that regulate flight, that both branches of aeronautics should receive the attention of men of science in its divers branches. To take one example, "The Protection of Captive Balloons from Lightning," this much-needed application demands the talents of the electrician.

Considering the immense importance of the international discussion of these aeronautical needs, it is earnestly hoped that Great Britain will be adequately represented at this important congress, and that many of the members of the Aeronautical Society of Great Britain will be present. That international congresses on scientific matters are a necessity of the age is now fully realised in this country. Great Britain has in fact been much to the fore in encouraging international co-operation. Each succeeding year shows that the great Parliament of science—the British Association—tends to become more and more international in its character. It is, in fact, fast becoming a great centre of cosmopolitan interest. Last year it selected Dover for its annual meeting-place, chiefly because it was so near the town on the other side of the Channel, in which the French association had elected to hold their meeting. By that friendly movement on the part of the British Association, the distinguished men of science of each nation intermingled in each other's sections, to say nothing of the pleasant social international gatherings that gave recreation and relief after the sterner sectional proceedings.

Digitized by Google

As most of the flourishing branches of natural science, chemistry, physics, geography, geology, physiology, and meteorology have each in late years been expanding their horizons under the benign influence of international congresses, so, too, will the young science of aeronautics develop and grow maturer under the influence of the diverse thoughts and ways of many nations tuned into harmony by international congresses. In attending international scientific congresses, where men of various nations are striving after one end only, the discovery of truth, besides furthering the advance of any particular science, each is aiding in the great movement which must in the end tend towards consolidating the peace of nations. It is the opinion of many of the distinguished men of science in different countries that the spread of science through the medium of international scientific congress is steadily making for peace. To quote the words of Sir Michael Foster, in his Presidential Address to the British Association at Dover last September:—

"Moreover, not in one branch of science only, but in all, there is a deep undercurrent of influence sapping the very foundations of all war. As I have already urged, no feature of scientific inquiry is more marked than the dependence of each step forward on other steps which have been made before. The man of science cannot sit by himself in his own cave weaving out results by his own efforts, unaided by others, heedless of what others have done and are doing. He is but a bit of a great system, a joint in a great machine, and he can only work right when he is in due touch with his fellow workers. If his labour is to be what it ought to be, and is to have the weight which it ought to have, he must know what is being done, not by himself, but by others, and by others not of his own land, and speaking his tongue only, but also of other lands and of other speech. Hence it comes about that to the Man of Science the barriers of manners and speech which pen men into nations become more and more unreal and indistinct. He recognises his fellow worker wherever he may live and whatever tongue he may speak, as one who is pushing forward shoulder to shoulder with him towards a common goal, as one whom he is helping and who is helping him. 'The touch of science makes the whole world kin.'"

ERIC STUART BRUCE, M.A. Oxon.

NOTES.

Lord Rayleigh on "Flight."—Lord Rayleigh, the Professor of Natural Philosophy at the Royal Institution of Great Britain, is announced to give a Friday evening discourse on "Flight" at the Royal Institution on Friday, January 19th next. That so profound a mathematician, so sound a philosopher and so fertile an experimenter should have taken up this important subject and consider it worthy of his time marks a new era in aeronautics. It should do much towards dispelling the popular prejudice which has to some degree existed concerning the subject. No longer can the epithet dreamer be applied to anyone because he is a student of aeronautics. Like all other scientific subjects, aeronautics has its dreamers. Those who imagine that by merely indulging in a moment's fancy, committing it to a piece of paper and presenting it to the Patent Office, they have without observation or experiment solved the most difficult problem in the world. How Lord Rayleigh will treat this fascinating subject, and how far he will hold out hopes of man's attainment of the flying art is still unknown, and his discourse is awaited with the most intense interest and curiosity.

A Possible Use of Montgolfier Balloons in War.—Mr. Henry Coxwell has lately addressed a letter to the "Standard," in which he proposes the use of Montgolfier hot-air ballons in war, in places which do not admit of the transport of the ordinary balloons and their appendages When reconnoitring close upon the heels of a mobile enemy, he considers the Montgolfier principle would be specially valuable, and he suggests that the inflating power might in an emergency be obtained from mere straw. "With such a balloon made from a new material—which is an animal substance, and now manufactured, I am told—the ascent could be easily managed if the balloon were used without netting or heavy appendages, and it would be suitable for rapid observations, and for getting clear of the enemy before any harm could be done to it, as the inflation and exhaustion of such a machine could be accomplished expeditiously. Under the more favourable auspices of such a new departure, the concealment of the Boers beneath the river banks and the massing of them before they entered their ambuscades

Digitized by Google

might perhaps have been seen in the nick of time." Like most opinions of this aerial expert, this seems to be one that is thoroughly practical.

The Application of Wireless Telegraphy to Balloons.—The "Engineer" has lately commented on a proposal whether wireless telegraphy might not with advantage be used to explode and release shells carried up by passengerless fire balloons. The position of such a balloon might be followed a long way off by observers stationed at the extremities of a sufficiently long base line to give some measure of accuracy, and on the signal being given the shell might be released with a view of destroying armies and cities. The "Engineer," however, considers that there are difficulties in the way of such an aerial bombardment. "It is very difficult, perhaps impossible, to cause the balloon to travel exactly over the desired spot. If the directing or starting point is ten miles off, it may be questioned if the balloon would ever travel over a desired mark of small area; and if the mark is of large area, it may be questioned what good would be effected by it. We know in fact that it has been deliberately laid down by high authorities that in the attack of a fortress all shells are wasted which do not strike an actual gun or a magazine. This must, no doubt, be subject to some modification; but it is generally true that the useful targets are very small objects, such as it would be hopeless to get a free balloon plumb overhead from a distance approaching ten miles. Thus the balloon attack would resolve itself into one of general bombardment. This is open to grave objection. It generally means a useless destruction of life and property, for rarely indeed has any reasonably strong place been captured by such means. Further, at the Hague Conference, if we remember rightly, this particular form of attack was one given as an example of brutal, unpermissible warfare." But if the aerial balloon bombs are condemned, ought not the same censorship to be applied to the torpedo, which, not visible like the balloon, but hidden beneath the surface of the water, and fired from a distance with serpent-like wilyness, destroys whole warships and thousands of lives. Few will be keen on recommending the adoption of aerial bombs, but Peace Conferences should be logical.

The Duke of Argyll on the Zeppelin Air Ship.—Up to the date of going to press, no news concerning experiments with the Zeppelin air ship has come to hand, and the event of a trial trip is still awaited with interest. Owing to delay, some are asking whether, after the vast expenditure lavished on the air ship, the world is going once more to be disappointed? But in such a prodigious and novel undertaking, delays are inevitable and perhaps expedient, and it will be wise for the public to reserve its opinion until further news arrives.

The Duke of Argyll, who for years has been a profound student of avian flight, has thus criticised the Zeppelin method in a letter to the "Times." The Zeppelin air ship is constructed on a principle directly the reverse of that on which Nature solves the problem when she has to deal with it. In the case of the Zeppelin air ship, the whole structure is to be lighter than the air it will displace. Whereas in the case of flying animals, every one of them is constructed on the opposite principle of weight-lifted and guided by mechanical energy. "There is not a flying animal in the world, from the smallest midge to the largest bird, like the condor, which is not always heavier than the air in which we stupidly describe it as 'floating.' If you worked the organs of mechanical energy, every flying animal falls like a stone." No one will deny the soundness of these views; but in the absence of any complete knowledge in the way of imitating the "glorious and exquisite mechanism of avian flight," it would seem expedient to improve the balloon as far as possible, even if it is destined only to be a temporary and imperfect instrument of air navigation. For after all, at the present moment, the balloon is the only means by which we can rise in the atmosphere to a height of five or more miles, and there, with instruments of research, unravel its mysteries.

* * * * *

We understand that the Central Aeronautical Establishment that M. Georges Bescangon, the Aeronautical Engineer, has been managing has just been amalgamated with the large Aeronautical Factories of Champ de Mars, which belong to the well-known aeronaut Edward Surcouf, and have been re-constructed at Billancourt.

M. Georges Besangon, the aeronaut, is

Digitized by Google

leaving off manufacturing balloons so that he may exclusively devote his attention to the study of aerial navigation, aerial experiments, and scientific balloon ascents.

Obituary.

While this journal is in the press, we have received the news of the death of the famous aeronaut, Mr. Henry Coxwell, who was an honorary member of the Aeronautical Society. It would ill befit the memory of the great balloonist to devote only a few words to his career of usefulness. We therefore hope in the next number of this journal to give an account of his life and experiences.

Foreign Aeronautical Periodicals.

L'Aeronaute (Paris).

Octobre, 1899.—Séances des 5th and 19th Octobre, 1899 de la Société française de Navigation Aérienne.—L'Ascension de M. le Comte de Castillon de St. Victor.—L'Ascension du ballon l'Aéro Club. Le Record de la durée du monde entier. Deux Jours et Deux Nuits dans les Airs. Voyage à travers la France.—Préces inédit des travaux faits à L'Académie des Sciences de Paris, pour la perfection des machines Aérostatique, rèdige par le Général Meusnier.

Novembre, 1899.—E'loge de M. Gaston Tissandier par M. J. Janssen.—Séance de 2 Novembre, 1899, de la Société française de navigation aérienne.—Ascension de "La vie au grand Air."—Ascension du "Centaure."—Congrès international d'Aéronautique.

La France Aerienne (Paris).

15 au 31 *Octobre*, 1899.—La sélection du Colombier: E. Caillé.—Colombophilie et automobilisme: G. Guibourg.—Observations météorologiques à marseille: R. Guérin.—L'avant-Garde de Paris: E. Caillé.—A la volée.—Alea jucta est (suite): E. Cruchet.—Aéronautique au jour le jour.—Expédition Andrée.

1 au 15 *Novembre*, 1899.—Bulletin météorologique mensuel.—Marine et Colombophilie: De la Rochelle au Phare des Baleines: Docteur Ox.—La Colombophilie à L'Elysée.—Fédération Colombophilie à L'Elysée.—Fédération Colombophile de Lyon.—La France aérienne en vendée.—Le Messager de L'Océan.—Pigion.—A propos du Ballon dirigeable: G. Guibourg.—L'espérance de Caen.—A la volée.

15 au 30 *Novembre*, 1899.—Brélan de Congrès: Dr. Ox.—L'Aéronatique à l'Exposition de 1900: G. Guibourg.—La Colombophilie au jour le jour.—La Manche de Dieppe.—A la volée.

1 au 15 *Decembre*, 1899.—Bulletin météorologique mensuel.—Nos Sports à l'Exposition de 1900; L'aviateur Rose: C. Jobert.—L'avenér de l'aviation.—Académie d'aérostation météorologique de France.

15 au 30 *Decembre*, 1899.—Silence aux Pauvres: Dr. Ox.—L'Aéronautique à l'Exposition de 1900.—Les Science aériennes au jour le jour.—Aèrostat système de L'ingénieur A. Rallu.

Zeitschrift fur Luftschiffahrt (Berlin).

October.—Beiträge zur Kenntniss der atmosphärischen Elektricität.—Buttenstedt, Perpetuum mobile und Schwerkraft-Spannung.—Kleinere Mittheilungen: Dienstbach, zur Berichtigung.—Dienstbach, zu Herrn G. Koch's Erwiderung.—Platte, der Weg Zam Zicle ist den Aviatikern durch die Natur der dinge für immer verschlossen.—Buttenstedt, zu Stentzel's Ausführungen.—Buttenstedt, Eine Kleine Bemerkung.—Vereinsnachrichten: Deutscher Verein zur Förderung der Luftschiffahrt zu Berlin.

November.—Beiträge zur Kenntriss der atmosphärischen Elektricität (Fortsetzung).—Mimführ Flugtechnische Betrachtungen I.—Kleinere Mittheilugen: Platte die Irriehre vom Wellenfluge.—Dienstbach, zur Theoretischen Beurtheilung der Kress'schen Druchenfliegers.—Weissse, Emil Jacob über Buttenstedt.—Vereinsnachrichten: Deutscher Verein zur Förderung de Luftschiffahrt zu Berlin.

Notable Articles.

Oct. 3. *Times*.—Letter to the Editor, "Military Ballooning." Henry Coxwell.

7. *Spectator*.—"The Art of Flying."

7. *Daily Graphic*.—"The Late Mr. Pilcher." (By one who knew him.)

7. *Field*.—"Aerial Flights."

13. *The Practical Engineer*.—"Aerial Navigation."

14. *Spectator*.—"The Art of Flying." Letter to the Editor by E. F.

Digitized by Google

Oct. 21. *Standard.*—"Despatch Balloons in War." Letter to the Editor by HENRY COXWELL.

24. *Times.*—"Aerial Ship." Letter to the Editor by THE DUKE OF ARGYLL.

27. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by HORATIO PHILIPPS, and H. W.

Nov. *Fortnightly Review.*—"The Art of Flying." By W. E. GARRETT FISHER.

1. *Daily Graphic.*—"Balloons in War." (Illustrated.)

3. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by SIDNEY H. HOLLANDS.

8. *Sketch.*—"Science and War." (Illustrated.) (The Deputation of the Members of the Aeronautical Society of Great Britain, including Sir W. Crookes, F.R.S., and Mr. Hiram Maxim, bidding farewell to Major Baden-Powell on his departure to South Africa.)

10. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by W. G. WALKER, A.M.I.C.E.

11. *Land and Water.*—"The Sport of the Future."

21. *Times.*—"In Quest of the Leonids." By the Rev. J. M. BACON.

23. *Times.*—"Mr. Bacon's Balloon Voyage.' Letter to the Editor by EDWARD J. FORSTER.

23. *Nature.*—Note on the Application of Science to Modern Warfare.

Dec. 10. *New York Herald.*—M. Santos-Dumont in his Balloon. (Illustrated.)

22. *London Letter.*—"Balloons in War."

Applications for Patents.

(*October, November, December*, 1899.)

20,739. October 17. CYRUS ARMITAGE, 30, Park Row, Leeds. Improvements in, or in Connection with, Aerial or Flying Machines.

21,848. November 1. JOHN WORTHINGTON, Beach Avenue, Blackpool. Improvements in Flying Machines for Conveying Human Beings through the Air.

22,763. November 15. JOHN JONES, 41, Reform Street, Dundee. A New or Improved Flying Machine or Air-Ship.

23,313. November 22. JOSEPH JOHN WILFRED HAMILTON, The Abbey, Penzance. The Flying Machine Balance.

23,314. November 22. JOSEPH JOHN WILFRED HAMILTON, The Abbey, Penzance. The Square Flying Machine.

23,605. November 27. JOHN JONES, 41, Reform Street, Dundee. A New or Improved Flying Machine or Air-Ship.

24,047. December 2. ALFRED JULIUS BOULT, 111, Hatton Garden, London. Improvements in or Relating to Air-Ships or Vessels.

24,393. December 7. REGINALD MANSFIELD BALSTON, 46, Lincoln's Inn Fields, London. Improvements in Flying Machines.

24,394. REGINALD MANSFIELD BALSTON, 46, Lincoln's Inn Fields, London. Improvements in Fluid Pressure Motors Suitable for Use in Flying Machines, Road Vehicles, and other Apparatus.

24,777. December 13. JOHN JONES, 197, Princes Street, Dundee. Improvements in the Construction and Apparatus of Air-Ships and Flying Machines, and the Method of Raising, Propelling, and Guiding the same.

24,848. December 14. FRANCIS ALEXANDER BARTON, 7, Quality Court, Chancery Lane, London. Improvements in Navigable Balloons or Flying Machines.

24,862. December 14. EDWARD REDMOND LINDSEYE, Killooney Lodge, Armagh. An Improved Balloon, called the Safety Balloon.

Patents Published.

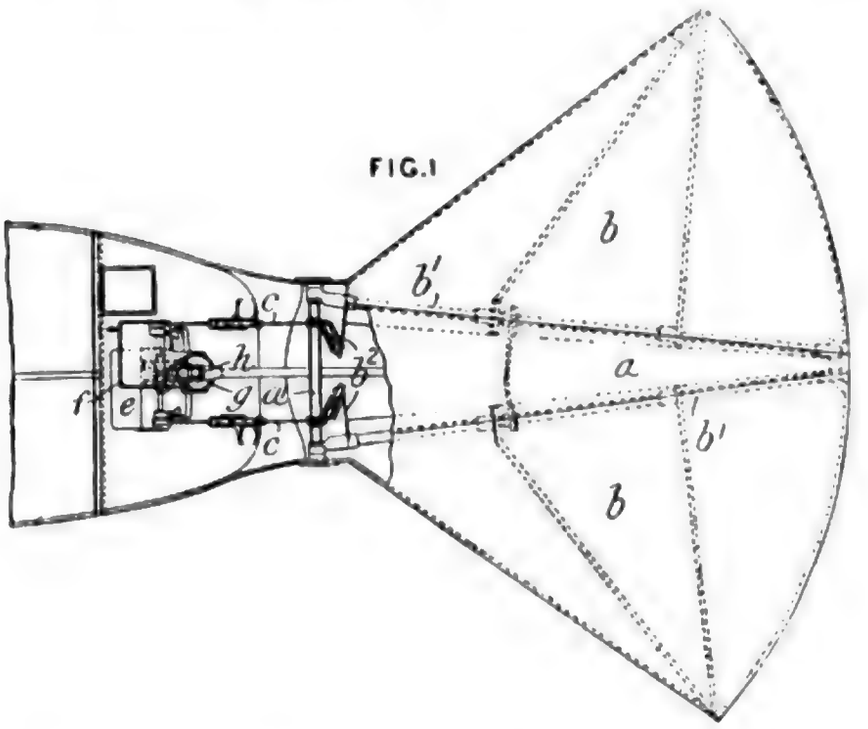
13,700. June 20. Flying Machines. DAVIDSON, G. L. O., 59, Jermyn Street, Middlesex.

Steering.—The machine is kept in equilibrium by a tail composed of three parts a, b, b and shown in plan. The part a is capable of turning about a horizontal shaft a^1, and is operated by a vertical screw g and nut h. The parts b turn about shafts

Digitized by Google

b^1 on the part a, and are operated simultaneously in opposite directions by levers b^2 and chains c. The motors e and f, that operate the chains and screw respectively, are started and stopped automatically by a pendulum mounted on a universal joint.

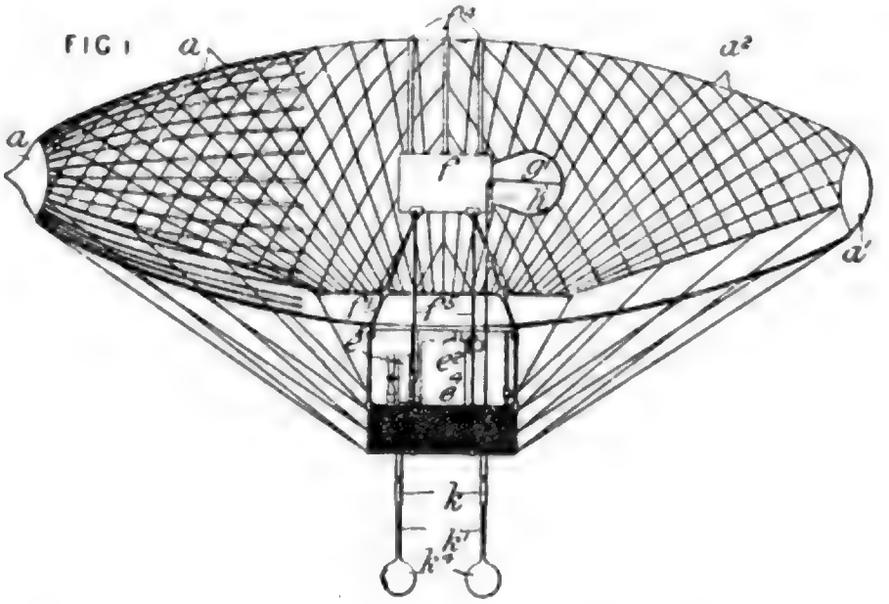
FIG. 1



15,324. July 12. **Aerial Machines.** HITE, C. E., 103, South 34th Street, Philadelphia.

An elongated balloon A of flexible material is protected at the ends by metal caps a, a^1 secured by the netting a^2 and is made rigid in front by rods a^4. It has in its interior a bag which is inflated or deflated according to the pressure of the gas in the balloon A. The balloon communicates with a gas-holder comprising a light metal cylinder containing a goldbeater's skin bag in the car, and the gas in it is continuously circulated by a fan e^5 through a pipe e^4, e^2 in the car heated by a lamp. Propulsion is effected by two fans at the forward ends of the lateral tubes f, which are supported by hinged struts f^1, f^5 projecting from the car and by cords f^4 passing over the top of the balloon, so that, when the latter is deflated, the tubes fall down level with the bottom of the car. A rudder g^1 is pivoted to the side next the bottom of the rear end of each tube f and is drawn more or less across the tube by a cord h. The car carries ballast bags k^4 which are emptied by collapsing them by means of a cord fixed to the bottom inside; the tubes k^1 supporting them may be drawn up inside of the tubes k.

FIG. 1



Digitized by Google

16,181. July 25. **Aerial Machines.** LOCHNER, M., 160, Kantsrasse, Charlottenburg, Germany.

The machines are provided with an aeroplane *c*, Fig. 5, shaped like half a parachute with a rigid forward edge *f* which catches air currents; these air currents escape from beneath the aeroplane at its rear end in such a direction as to give the machine an impulse in the opposite desired direction. A spherical aerostat may be constructed with a stiff inclined band around it, the lower part of the aerostat being folded inwards about this band so as to form an aeroplane. The propellers, Figs. 1 and 2, are constructed so as to act on a similar principle, the direction of the air currents being shown in Fig. 2, which is a section on the line A—B, Fig. 1, and the direction of rotation by the arrows. The front *c* of the propeller is rigid, and the rear *d* of yielding sail material.

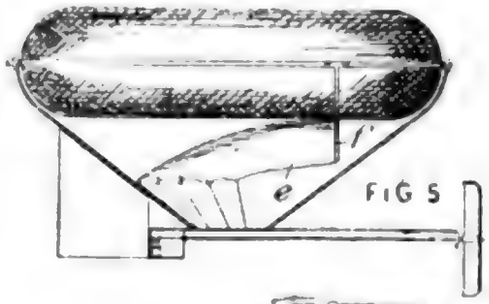


FIG 5

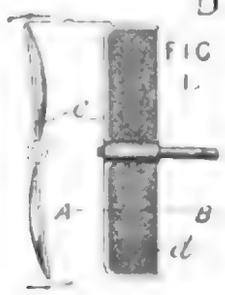


FIG 1.



FIG 2

Digitized by Google

620.5
A245

PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MI
AUG

THE AERONAUTICAL JOURNAL



No. 14. APRIL, 1900. VOL. IV.

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	113
LORD RAYLEIGH ON "FLIGHT"	113
MAJOR BADEN-POWELL'S WAR EXPERIENCES	117
AERONAUTICAL SOIREE AT THE ROYAL INSTITUTION	117
THE PILCHER COLLECTION OF SOARING MACHINES	118
THE BALLOON WORK OF THE LATE MR. COXWELL (*Illustrated*). BY ERIC STUART BRUCE, M.A., OXON.	118
A THEORY OF FLIGHT. BY D. M. BOWYER SMYTH	120
RECENT PUBLICATIONS:—"SAILING BIRDS ARE DEPENDENT ON WAVE POWER," WITH REVIEW BY MR. HIRAM MAXIM	122
NOTES:—THE GRAND PRIZE OF THE PARIS AERO-CLUB—THE TRIUMPH OF THE BALLOON IN SOUTH AFRICA—MEN OF THE MOMENT—ELECTRIC BALLOON SIGNALLING AT THE PARIS EXHIBITION—A NEW FLYING MACHINE—NOVEL USE FOR BALLOONS—THE NUMBER OF COXWELL'S AND GODARD'S ASCENTS—THE FIRST USE OF THE BALLOON IN SOUTH AFRICA	124
OBITUARY:—PROFESSOR HUGHES—COLONEL ELSDALE	126
FOREIGN AERONAUTICAL PERIODICALS	126
NOTABLE ARTICLES	127
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED	127
NOTICE TO A CORRESPONDENT	128

LONDON:
PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., 12, GOUGH SQUARE, 4, BOLT COURT, AND 4, BIRCHIN LANE, E.C.

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

CRYSTAL PALACE,

SYDENHAM.

The Pilcher Collection of Soaring Machines, including the Machine on which the late Mr. PERCY PILCHER met with his fatal accident, are now on view by arrangement with the Aeronautical Society of Great Britain.

THE AERONAUTICAL JOURNAL.

JULY, 1900.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor (pro tem.), 19, Campden House Road, Kensington, London, W.

NOTICES OF The Aeronautical Society.

GENERAL MEETING.

The next General Meeting of the Aeronautical Society will be held in the rooms of the Society of Arts, John Street, Adelphi, on Tuesday, July 17th. The chair will be taken, at 8 p.m., by Major H. C. Roberts. The following papers will be read :—

1. "Cloud Photography from Balloon," by the Rev. J. M. Bacon, illustrated by photographic lantern slides.
2. "Portable Electric Balloon Signalling in War," by Mr. Eric Stuart Bruce, M.A., Oxon., illustrated by lantern views, working models, and experiments.
3. "The Weczera Flying Machine," by Mr. L. W. Broadwell, with exhibition of the model of the machine, which has lately arrived from Hungary.
4. Foreign Communication.—Dr. K. Danilewsky's Flying Machine, illustrated by photographs supplied by the inventor.

During the evening some lantern views depicting Major Baden-Powell's latest kite experiments at the front will be projected on the screen.

ERIC STUART BRUCE,
Honorary Secretary, pro tem.

In reply to numerous enquiries from members of the Aeronautical Society and others concerning news of Major Baden-Powell, the Honorary Secretary (*pro tem.*) has pleasure in stating that he lately received a letter from Major Baden-Powell, which contained the welcome news that he was then "very well and fit." Though temporarily absent from the duties of the Honorary Secretaryship of the Aeronautical Society, he takes the keenest interest in the proceedings and welfare of the Society and its journal, and is a contributor to the present number.

Aeronautics at the Paris Exhibition.

1. THE AERONAUTICAL EXHIBITS.

Perhaps it may be taken as a sign of the vitality of the science of aeronautics in 1900, that one of the few exhibits to be ready amidst the chaos and utter desolation of the opening day of the Paris Exhibition of 1900 was the large Flying Machine suspended from the roof of the French Aeronautical Section. Not that much commendation can be bestowed on the particular machine exhibited, for, though its huge wings were of sensational interest to the multitude, to the expert they were suggestive as being rather an advertisement for a light motor than of probable practical utility.

The French aeronautical exhibit is mainly of historic interest, but an hour may be pleasantly spent in examining the various relics that have been collected together, and which were made so intensely interesting to the writer, who had the privilege of having them explained by so versed a balloonist as Monsieur De Fonvielle.

Digitized by Google

Amongst the exhibits particularly interesting are the paintings on dinner service plates, exhibited by M. Albert Tissandier. These are descriptive of the early balloon ascents, and include the ascent of Charles, the inventor of the gas balloon, from the gardens of the Tuilleries. This unique collection shows what an impression the early balloons made on the popular mind in France.

There are many relics of interest connected with the memorable use of balloons during the Siege of Paris, an episode in balloon history which has never been more graphically described than it was in Major Baden-Powell's lecture at the United Service Institution some years ago, and which is, without doubt, the greatest example on record of the possibilities of the free balloon. Amongst these relics is the balloon, "La Volta," by means of which M. Jansson escaped from the besieged city. Very graphically did M. Albert Tissandier describe to the writer the story of this aerial voyage. How the Germans offered M. Jansson his freedom, if he wished to leave Paris to make a scientific expedition. But M. Jansson refused their generous offer. What need of it when he had his balloon and the free air! In the car of the balloon now on view at the Exhibition, M. Jansson, of his own free will, left the French capital.

There are also on view the medals won by the balloonists who left Paris during the siege. There are also interesting relics of the fatal balloon accident by which Messieurs L'Hoste and Mangot lost their lives while endeavouring to cross the Channel, including the valve of the balloon Arago.

2. THE AERONAUTICAL COMPETITIONS.

Practical Aeronautics in 1900 is to be represented by the Balloon Competitions rather than by the exhibits in the interior of the buildings. These are to take place in the Bois de Vincennes, from the 17th June to the 30th September. (See table on page 131.)

3. THE INTERNATIONAL AERONAUTICAL CONGRESS.

The programme of the International Aeronautical Congress was published in the January number of this Journal. The dates are now announced to be from 15th to 20th September. Colonel Jekyl, the Secretary of the Royal Commission of the Paris Exhibition, has informed the Honorary Secretary of the Aeronautical Society that it is the intention of Her Majesty's Government to send a special delegate to represent Great Britain at the sittings of this important Congress. It is satisfactory that the published list of the members of the Congress include the names of some of the members of the Aeronautical Society of Great Britain. It may reasonably be expected that several other members of the Society will join in the proceedings.

Mr. Eric Stuart Bruce's Address to the Members of La Société Française de Navigation Aerienne, on "The Aeronautical Society of Great Britain and the Work of the Members of its Council."

On the occasion of Mr. Eric Stuart Bruce's recent visit to Paris in connection with his electrical signalling balloon exhibited in the Paris Exhibition, he met with a most cordial reception by La Societe Française de Navigation Aerienne," being not only immediately invited by Monsieur Triboulet to attend the Council Meeting of that Society, to make the acquaintance of the President, Monsieur De Fonvielle, and other members of the council, but also being asked to address the General Meeting of the Society, on May 3rd, on the subject of "The Aeronautical Society of Great Britain, and the Work of the Members of its council, with Special Reference to the Use of the Balloons in the South African War." This address is given in full below. The promise of Monsieur De Fonvielle to come over to England to address the British Society on the subject of his scientific balloon work will, no doubt, meet with the warmest appreciation on the part of the members of our Society.

In introducing Mr. Bruce to the meeting, Monsieur De Fonvielle, the President of the meeting, said that he, like all those present, held those philosophers not to have been in error who hailed the invention of the balloon as the surest method of bringing about universal peace. Yet, so far, it was the needs of war that had stimulated balloon development. The glorious proof of this was the war balloons constructed at Meudon, and used at the end of last century, and the balloon post of the siege of Paris. It was to these two eventful successes that was owing the present aeronautical renaissance—a renaissance so active that the meetings of the French Aeronautical Society could barely cope with the new facts to be registered. We are not, there-

Digitized by Google

TABLEAU DES DATES DES CONCOURS ET DES PRIX.

DATES DES CONCOURS. (1)	NATURE DES CONCOURS. (2)	SÉRIES. (3)	1er PRIX.		2e PRIX.		3e PRIX.	
			PLAQUETTE.	PRIME.	PLAQUETTE.	PRIME.	PLAQUETTE.	PRIME.
				francs.		francs.		francs.
17 juin	Concours de durée pour ballons libres montés.....	1re série.	V.	500	A.	200	B. A.	100
24 juin	——— d'altitude pour ballons libres montés	1re série.	V.	200	A.	100	B. A.	
1er juillet	——— de ballons historiques		A.	400	B. A.	200	B.	100
	——— de montgolfières		A.	200	B. A.	100	B.	
15 juillet	——— de distance minimum par rapport à un point fixé à l'avance pour ballons libres montés	1re et 2e séries.	A.	200	B. A.	100	B.	
22 juillet	*Idem*	3e série.	A.	200	B. A.	100	B.	
29 juillet	Concours d'altitude pour ballons libres montés	2e série.	V.	200	A.	100	B. A.	
12 août	— — de plus longue distance parcourue pour ballons libres montés	1re série.	V.	500	A.	200	B. A.	100
	Concours de diagrammes.....		A.		B. A.		B.	
19 août	——— de cerfs-volants		V.	200	A.	100	B. A.	
26 août	——— de durée pour ballons libres montés	2e série.	V.	500	A.	200	B. A.	100
9 septembre	——— de plus longue distance parcourue pour ballons libres montés.....	2e série.	V.	500	A.	200	B. A.	100
	Concours de photographie en ballon dans un même concours.....		A.	100	B. A.	50	B.	
16 septembre ..	Concours de durée pour ballons libres montés..	3e série.	V.	500	A.	200	B. A.	100
	——— de cerfs-volants		V.	200	A.	100	B. A.	
20 septembre .. (Départ de nuit.)	——— de plus longue distance parcourue pour ballons libres montés	3e série.	V.	500	A.	200	B. A.	100
	Concours d'éclairage pour ascensions nocturnes.....		B. A.	200	B.	100	"	
23 septembre ..	——— de procédés de gonflement des ballons.....		A.	200	B. A.	100	B.	
	——— de ballons sondes.....		V.	200	A.	100	B. A.	
	——— d'altitude pour ballons libres montés	3e série.	V.	200	A.	100	B. A.	
	——— de compte rendu dans un même concours ..		B. A.		B.			
30 septembre .	——— au 2e degré, de plus longue distance parcourue pour ballons libres montés		V.	1,000	A.	500	B. A.	200
	Concours au 2e degré, de durée pour ballons libres montés		V.	1,000	A.	500	B. A.	200
Du 17 juin au 30 septembre.	——— de photographie en ballon dans l'ensemble des concours....		A.	100	B. A.	50	B.	
	Concours de compte rendu		B. A.	"	B.	"	"	
	Grand-Prix de l'aéronautique		Or.	1,000	"	"	"	"

N.B. La 1re série de ballons libres sera composée de ballons de volumes sensiblement égaux et handicapés quant au lest.
La 2e ——— ——— ——— de ballons de volumes quelconques et handicapés.
La 3e ——— sans conditions de lest.
Les plaquettes sont en or ; en vermeil V. ; en argent A. ; en bronze argenté B. A. ; en bronze B.
Le Grand-Prix de l'aéronautique sera attribué à l'aéronaute qui, dans l'ensemble des épreuves de durée, d'altitude et de distance horizontale pour ballons libres montés, aura réuni la plus grande valeur de prix.

Digitized by Google

fore, surprised to find another war—the Anglo-Boer war—providing occasion for further developments in aerial navigation. Let us forget for a moment the streams of blood inundating the richest country of the ancient African Continent, and realise that notwithstanding steps towards the conquest of the air, steps of peace and humanitarianism are being made. For it cannot be in vain that the great and commercial nation to whom is due much of the progress in the industrial arts shall have been directing her engeries to aeronautics. It was with the greatest satisfaction that he informed the meeting of the presence that night of Mr. Eric Bruce, the temporary Honorary Secretary of the Aeronautical Society of Great Britain, who would now address them, informing the French Society of their colleagues across the Channel, and of what they had done for their country in the present crisis. There was no need for him, he felt, to ask the sympathetic interest of the meeting in Mr. Bruce and the Society he represented. Mr. Bruce would speak in English, and he himself would have the privilege of translating his remarks, passage by passage as delivered, into French. (Much applause.)

MESDAMES ET MESSIEURS.

I have been asked by your distinguished President, M. De Fonvielle, to address to you this evening a few words concerning the Aeronautical Society of Great Britain, and especially concernng the work of the members of its council. I wish first to express my appreciation of the honour that has been conferred on me by the invitation to address your society—an honour which is enhanced by the fact recognised by all Englishmen that France is ahead of all nations in the science of aeronautics, and that La Societe Francaise de Navigation Aerienne which I am now addressing, may, with sincerity, be called the first Aeronautical Society in the world.

The permanent secretary of our British Aeronautical Society, is, as I think you probably all know, the distinguished Major Baden-Powell of the Scots Guards, the younger brother of the famous defender of Mafeking. He is at present absent with his regiment at the front in South Africa. During his absence I have the privilege of fulfilling his duties.

Our British Aeronautical Society was for many years conducted by the late Mr. Frederick Brearey, who, I have no doubt, was known to some of your council. His chief aim was to develop flying machines, and he invented several working models which I have myself seen fly round a large hall. All models will not do this. I believe these machines were very akin to those invented by M. Penaud. During Mr. Brearey's lifetime, the British Society, though containing several distinguished members, had not been large.

Some time before his death, Mr. Brearey asked me whether, when he gave up the work, I would undertake the honorary secretaryship of the Society in his place; but at that time I did not see my way to undertake so serious a duty. Shortly after Mr. Brearey's death, the council asked Major Baden-Powell to accept the post of honorary secretary, and with the energy which is characteristic of the Baden-Powell family, he rapidly infused new life into the Society, increased the quantity and quality of the members, enlarged the council, and developed the quarterly journal—making it the interesting and useful chronicle of aeronautical matters it now is. Major Baden-Powell is the inventor of the war kite of hexagonal shape, which has not only taken up photographic instruments, but also lifted men to considerable elevations for observation purposes.

Before I pass on to say a few words about the other members of our council, I will say a few words concerning Major Baden-Powell's war kites, and of the use of balloons in the South Africa war. The principal use to which Major Baden-Powell has applied his kites in this war has been in connection with M. Marconi's wireless telegraphy. There were no poles long enough to be of any use, but Major Baden-Powell came to the rescue with his kites, and the apparatus was successfully reared to the necessary height in the air, and messages transmitted for a great distance—in some cases 85 miles. He also applied his kites on Modder River to the taking of photographs at great heights of camps, tents, guns, etc.

Several completely equipped balloon parks have been despatched by our Government to the seat of war in South Africa, both in the eastern and western arenas, and the captive observation balloons have proved of the utmost value throughout the campaign. Their manipulation was under the direction of various officers, Capt. Jones, R.E., and others, trained by Colonel Templer, a distinguished member of our council, and who is the instructor in ballooning to the British Army, which means that every officer in the army who is destined for the balloon service is trained by this expert and intrepid aeronaut.

This distinguished member of our council is also at the front. He is not only in charge of the balloon equipment, but he has had a

Digitized by Google

special command entrusted to him as superintendent of the military transport traction engines and waggons. He was shipwrecked on the way out with all his horses and engines, but finally arrived safely.

The British war balloon is made of gold-beaters' skin, a substance admirably suited for the purpose, on account of its lightness and capacity of retaining the hydrogen, the desideratum of strength being obtained by a special process of which our balloon engineers are very proud. The gas for inflating the balloons is invariably compressed in steel cylinders and carried to the place of operation. During the siege of Ladysmith, the captive balloons were invaluable, the observers in the car locating the enemy's guns and directing the fire of the British artillery by telegraphing the observations to those below. At Maggersfontein the aeronauts did good service, and in one of General Buller's attempts to relieve Ladysmith, the eagle eye of the balloon saved our troops from marching into a death trap at Spion Kop. On one occasion a shell went through a balloon, and owing to the rents made, the balloon descended gradually to the ground without injuring the aeronauts. A day or two afterwards, the balloon again ascended, two patches showing that it had been a target for the fire of the enemy. The usefulness of the balloon in South Africa will have silenced for ever the criticisms of those who have disregarded its value in warfare, and grudged the national expenditure on the service of the air.

In speaking of the balloon equipment of the British Army, I may just mention that it has been my privilege to invent the system of electric balloon signalling, which I have supplied to the British Government, and also, I may add, to the Belgian and Italian Governments. This system will be shortly on view in Group XVIII. of the Paris Exhibition.

It is worthy of note that the Government are now establishing a balloon manufactory at Cape Town, which is an official recognition of the service the balloon has rendered during this war. Before I leave the subject of the war, I may mention that there is one other member of the council serving there. Lieut.-General Charles Warren. He successfully conducted a former war in Bechuanaland, and has just been appointed Governor of Griqualand West.

Time obliges me to mention, but very shortly, the other members of the council. Sir Edwin Arnold is an Indian authority and a poet, the author of the "Light of Asia." Mr. Barry is an indefatigable member of our council. Lord Crawford and Balcarres, a Fellow of the Royal Society, takes a wide interest in various sciences, and has been a President of the Royal Photographic Society. Sir William Crookes, also a Fellow of the Royal Society, is of world-wide renown. From his splendid researches have sprung the radiometer and the high vaccua tubes, the necessaria of the Rontgen radiation. Dr. Leslie Earle is an eminent physician, one of our most regular attendants at council meetings. Professor Fitzgerald, also a Fellow of the Royal Society, is a Professor of Trinity College, Dublin, Ireland, and is an authority on the Soaring Flight of Birds. Mr. Frost is a Justice of the Peace, and has specially given his attention to the development of flying machines. Major Fullerton, Royal Engineers, holds a high command in the Channel Islands. Mr. Glaisher, a Fellow of the Royal Society, an honorary member of our Society, is so well known for his scientific ballooning, and his famous ascent of seven miles, that I need hardly dwell longer on his work before such an audience of aeronautical experts. Mr. Hiram Maxim is the inventor of the Maxim gun which has been so much used throughout the South African war. He is also the inventor of the great flying machine on the aeroplane principle, which bears his name. Though he has not yet allowed his machines to fly off the rails upon which it has made several successful journeys, it is the opinion of some British experts that it is the most advanced flying machine yet designed, and would fly, if Mr. Maxim thought fit to let it do so. But the light engine and boiler has cost Mr. Maxim an enormous sum, and he doubtless has good reasons for delaying his final experiment. Major H. C. Roberts is another energetic and zealous member of our council, of long connection with the Society, and he has laboured for its development and wellbeing. On most occasions he takes the chair at our council meetings.

Amongst the names of our ordinary members who have made high and interesting balloon ascents lately, I should like to mention the names of the Rev. J. M. Bacon and Mr. Percival Spencer, of whose journeys you have doubtlessly read.

I should also mention the names of three members of our Society whom we have lately lost. The lamented Mr. Coxwell, the intrepid aeronaut who guided Mr. Glaisher in his high ascent; Mr. Pilcher, the inventor of the soaring machine which bears his name, in which he met his death, and which our Society is now exhibiting at the Crystal Palace, Sydenham; Colonel Elsdale, who, with Lieut-Col.

Digitized by Google

Templer, worked out for the British Government our goldbeaters' skin war balloon. I must also make mention to you of the death of the Duke of Argyle. He was formerly a member of our Society, and in days long past, meetings of the Society used to take place at his house on Campden Hill, Kensington. He was a man of many parts, eminent as politician, orator, litterateur, historian, geologist, and student of flight. He held numerous high posts in Great Britain, and reaped high honours. He was a Scot-man—a Highland chief—of that land of the mountain, gorge and flood, to which I am also proud to belong.

I hope these few hastily compiled details of our Society and members may have interested you a little in our endeavours. It is my most earnest wish to promote a warm and lasting friendship between La Societe Francaise de Navigation Aerienne of Paris and the Aeronautical Society of Great Britain. I know this will be to the advantage of the British Aeronautical Society, for I speak the heart of every British aeronaut when I say that when he comes to Paris he comes to learn. I feel strengthened in my desire, and encouraged in my efforts by the courteous consent of your President, M. De Fonvielle, to come to London to address our Society, towards the end of the year. I have, while I have been in Paris, heard from your courteous and hospitable Secretary, M. Triboulet, some details of the great Aeronautical Congress you are organising in connection with the Exhibition; and on my return to England it will be my privilege to make them known to our members, and to urge those who can, to take part in both the Congress and the balloon contests.

Several photographs in illustration of this paper were sent from England at the shortest notice, by Mrs. Baden-Powell, Sir William Crookes, F.R.S., and Mr. Hiram Maxim, and were much appreciated by the meeting.

The Secretary Bird and his Flight.

By Major B. Baden-Powell.

I know of no bird from which lessons in practical flight can be better obtained than from the Secretary bird. As one sees him stalking along with stately gait across the veld in South Africa, he reminds one rather of a very large pied pheasant, but with longer legs and an eagle-like head. But now let us gallop straight towards him and note carefully his successive actions. At first, he raises his head in a proud and offended manner, but then recognising the undoubted physical superiority of the mounted man, he hurries his steps and runs in an ungainly fashion, almost as if afraid. Then he slowly opens and extends his great wings till they are widely stretched outwards. His appearance then irresistably recalls to mind with grim sadness the scene, so impressed on my memory, of poor Pilcher's last attempts to solve the mysteries of flight. So this great bird runs for quite a distance, occasionally lurching slightly to one side or the other and gradually getting a hold on the air, so that it is plainly noticeable that his feet touch the ground more and more lightly, and his strides become longer. Then does he slowly but powerfully begin some great beats with his huge wings, the extremities of the feathers of which, singled out like the fingers of an outstretched hand, are turned upwards by the pressure of air. And now the transition 'twixt running and flying is reached. The toes, still violently worked, scarcely touch the ground, giving a mere scratch to assist the propulsion, and then the bird is fairly launched in mid air, when he usually at once rests from his evident exertions, and soars along quietly on outstretched wings. Often he will only go a few hundred yards thus, then dropping his legs to their full length he will gradually and cautiously sink earthwards, repeating his process of running so soon as the tips of his toes can reach mother earth, but not closing his wings until his speed is reduced.

On Forms of Surfaces Impelled through Air and their Effects in Sustaining Weights.

By F. H. Wenham, C.E.,

Honorary Member of the Aeronautical Society of Great Britain and of the Boston Aeronautical Society, Mass. U.S.A.

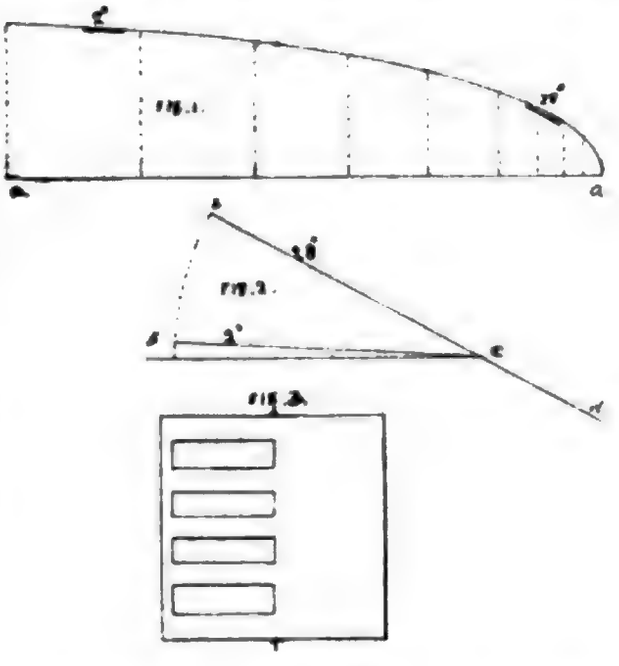
At the first meeting of the Aeronautical Society of Great Britain in June, 1866, the author read a paper "On Aerial Locomotion and the Laws by which Heavy Bodies impelled through Air are Sustained." Since that date, the writer has only occasionally reverted to the subject, but has never been convinced that flight is impossible for man, considering the apparent ease with which large birds traverse the air.

The power required to maintain the flight of the screw vanes mentioned in the paper (now

extensively used for flying-shot practice), was estimated at the rate of three-horse power for each hundred pounds raised. This is widely in excess of the reality, because when the first force that causes ascension is exhausted, the instrument in its subsequent descent, acts as a mere dirigible parachute. This is a most extravagant means of absorbing power. For example, a man weighing 150 lbs. attached to a parachute having this number of square feet, descending 1,300 feet per minute, will be expending six-horse power on the yielding air. This does not give us any knowledge of the power required for bird flight; neither is this to be arrived at by the recent gliding flights of man, for when the first impulse of rising—say against the wind—is expended, the rest of the traverse is performed at the expense of the power derived from the fall, with the waste pertaining to a parachute descent.

The superposed system of "aeroplanes" suggested by the author, involved no new principle. These planes were combined merely for the purpose of strength and lightness of construction, and in the case of a man-carrying machine to avoid an impracticable *length* of wing necessary for his support in rapid flight. The author made three of these full-sized "aeroplane" systems somewhat differing in construction, each on a scale sufficient to carry a man, but they were all so unstable or deficient in equilibrium that to attempt a flight by launching off from an altitude would to a certainty have caused an immediate accident, as will be shown presently. These narrow "aeroplanes" must not be superposed too numerously—not more than three should be used to shorten an impracticable length of a single wing to one-third. Another fallacy, still almost universal, is the supposition that a bird gains support by flying or soaring "against the wind." In free flight there is no such condition as "with the wind, or against it." After the first impulse given at starting, and the momentum from the earth is exhausted, the arrangement is absolutely in the moving body of air, and the force used in flight is alike in all directions, and the speed through the air itself the same. If the creature in flight was blindfold, he could not ascertain in which way he was going relative to the earth.

With a flat surface the air is immediately deflected by the first narrow streak in the front. This deflection is progressively increased by successive portions, till at length effective lift from the after part even of a narrow plane ceases, and for this reason must be a failure in consequence of imperfect support on the entire surface. What direction does the deflected under stratum of air take? It is supposed to be one of parabolic curvature, but this form terminates too abruptly. The author, by means of particles, and wind extended filaments, considers the curve to be a "catenary" or chain curve. With this the pressure recedes from the front edge, and becomes more evenly distributed over the following surface. It might be supposed that the after part loses effect by acting on yielding air. Such would be the case if the surface extended too far back, out of due proportion. The flat plane has to be set at a higher angle to get support on an average of errors. Give the surface the proper curvature, and what is the consequence? The front or entering angle is directly lowered because the pressure is carried backwards, and more evenly distributed over



the surface, and as the front has then less rise, this greatly reduces the "drift" or force required for propulsion. There is, perhaps, another condition. Though the under stratum of air takes the curve of the lower surface, does it do so above it? Probably not, but persists in a straight course; in this case there would be a partial vacuum over the after part of the wing, which would assist the lifting effect.

In cases where every ounce of effort needs to be economised, it is desirable to ascertain what portion of the catenarian curve is suitable for any sustaining surface required. Fig. 1, will demonstrate this: a.a represents the extent of a catenary Fig 2, b c.; the entering angle of 2°, b d, the leaving or terminal angle of 28°. These are assumed. Short lengths of these angles are adapted as chords to the curve, as in Fig 1, keeping the bases parallel; the inter-

Digitized by Google

mediate portion of the curve is scaled up by offsets from the base-line, in proportion to the size of the surface required.

In all that the author has written on the subject, no allusion has been made as to the application of a motor to a flying machine, because he has not been able to see the practicability of any known arrangement to which it could be adapted with a prospect of success. The idea for the next step has been, that a gliding machine capable of carrying a man should be so far perfected as to obtain the longest flight possible, derived from the force of the first impulse, and then by his own efforts ascertain how much farther he could extend his flight by his continuous exertion in working reciprocating propellers or rotating screw-vanes. Probably we should have arrived at this at an early date, if fatal accidents had not happened to experimenters, who had in practice entered the threshold of probable success. We should then have acquired some data for forecasting possibilities, for we are still ignorant of the power required to propel any machine quite suitable for flight.

Mathematical research and calculations have gone for nothing. In no branch of science have discrepancies and differences been so widely erroneous. The author has, therefore, been diffident about attempting to elucidate the subject by figures.

Occasionally, during high gales, some attempts have been made by the writer to gain additional knowledge by various models, but the capricious force of the wind, and its ever varying direction, baffled any definite results. Therefore, for the purpose of obtaining a perfectly steady current of air, a fan-blower has been employed. It may be remarked that the same condition of relative force exists through the air, if either the body is rushing through air, or the air against the body at a similar speed, and in this case we have the experiments upon stationary models under direct observation.

The blower is nine inches diameter at the fans, and makes 1,700 revolutions per minute, as driven by a foot-wheel and treadle. The exit orifice is 1¼ in. by 3 in., and the speed of the air issuing at the end of a guide trunk to ensure parallelism was at the rate of 25 miles per hour. This current required all the strength that could be exerted. The speed of this was measured by a Lind anemometer held in the blast, and verified by the direct force upon a plane surface. The models were held by two narrow spring clips at the sides, which could be adjusted at any angle. The axes of the clips were passed through the ends of two long arms at each side of the blower-case, to which they were pivotted. The short lengths of the arms at the back were connected by a shelf, upon which counterweights were placed, exactly to balance any models placed in front; these were limited in size to three inches square, in order to be within the column of issuing air. The weights for indicating the "lift" were not set upon or attached to the models, as this would have interfered with results, but were placed upon one of the side arms, in a cap in a line with the axes of the clips.

This same arrangement will not serve for measuring the forward resistance or "drift." This was effected by a vertical swing-arm, having similar adjustable clips and axes, central within the column of air from the nozzle of the blower. From a right angle arm, half the length of the vertical one, a scale pan was suspended, in which the weights were placed, which, of course, had to be estimated at half. It is not pretended that these results obtained could be strictly accurate, by reason of the small size of the surfaces experimented with. The blower should be at least eight or ten feet in diameter, driven by a 20 h.p. steam engine, or more.

The experiments were first tried with stiff cardboard, but as this appeared to be somewhat deflected by the vexatious lift, occurring mostly at the front edge, tinplate was substituted for the models.

Description of Models.	Angle or Rise.	Grains Lift.	Grains Drift.
1. Flat plane, three inches square..	6°	60	40
2. ,, with spar above in front $\frac{1}{10}$ in. thick	6	60	45
3. ,, circle, three inches diameter	6	60	30
4. ,, ,, with half area in centre cut out	6	60	45
5. Nine superposed bands slightly concave, arranged backwards in steps within a square of three inches	—	420	240
6. Three inches square, curved, entering angle 2½°, terminal angle 30°	—	360	45
7. Three inches square, curved, entering angle 2°, terminal angle 28°	—	380	42

Digitized by Google

REMARKS.

No. 2 shows that a spar or thickness over the front edge does not interfere with the lift, but much increases the drift. We may, therefore, infer that this, although a necessity in aerial machines, should be as thin as consistent with strength.

No. 3 shows that a circle has the same "lift," but less drift than a square of the same diameter.

No. 4. With a circular orifice having half the area of the circle cut out, the lift was not materially altered, but the drift is considerably increased. This confirms an experiment tried by the writer, with a plain circular kite in which the half area was afterwards cut out, with apparent equal efficiency termed a "ring kite."

No. 5. The same arrangement of superposed surfaces, proposed by the author, in the first issue of the Aeronautical Society in June, 1866, but with this difference, that the receding step-like arrangement would tend to prevent interference from each other with less distance in height. The lift of the arrangement is very great, and so is the drift, arising from too many edge resistances, which make the form too unwieldly to be of much use.

With Nos. 6 and 7 the results were very remarkable. So to term it, there was a degree of life and energy in this form of surface that the flat did not possess. On this point further remarks will follow.

A curious experiment was tried. A three-inch square was balanced on pivots as shown in Fig. 3, with half the area of one side cut away in four openings, leaving five narrow ribs, the open side was weighted, to compensate for the loss of material. On holding this in the blast, with the pivots vertical, the blank side having greater area, was driven back, the form taking an angle of about 65°. As the axis was brought towards the horizontal, till nearly parallel with the current, the open side rose up above the other, and had a greater lifting force than the close one. This explains a fact, that many persons may have noticed that some rooks at moulting time have lost most of the alternate primary feathers of one wing, so leaving openings; but instead of flying lop-sided, there is apparently no loss of balance, the support of one wing appears to be as good as the other.

The writer has long doubted whether flight can possibly be effected with *flat* aeroplanes. There is no such form in the wings of birds of passage, in which they are invariably concave beneath. Aeroplane or flat surface experiments are always difficult and unsatisfactory, from the lifting force persistently occupying the front edge. The after part of the surface does not assist much, and may be cut away or mutilated without detriment to the result. With flat surfaces we must adopt long planes extending laterally. We know where to begin, but not where to end, for obtaining the best advantage. *The whole secret and success in flight depends upon a proper concave form of the supporting surface.*

For comparison on a large scale if this 360 grains on the model surface of 1-16th of a square foot is increased in proportion 200 times, it will give a lift of more than 1 lb. per square foot. But the power to propel at 25 miles per hour must be estimated as the "drift." This is 45 grains taken at 200 times is equal to 1.56 lbs. at 2,200 feet per minute, equal to 3,432 foot pounds or about 1-11th h.p., or less than the half strength a man is capable of exerting. In this estimate no allowance is made for the resistance of frame work or appendages. The webs of a trial machine might be about three feet wide, in three tiers extending twenty feet from end to end sideways, thus spreading 180 square feet of surface. The great difficulty yet to be overcome is that of equilibrium during flight. More than thirty years ago the writer of this, made a winged model, duly weighted, which skimmed away steadily when launched from a house top; Mr. Glaisher was requested to drop it from the car in his next balloon ascent; he did so, and reported that it descended steadily for some dozen yards, then tripped and whirled over rapidly till it reached earth.

A long tail or expanse of surface aft under the instant control of the aeronaut must be considered as indispensable for the purpose of steering and balancing.

Mr. Hargrave's Paper on Sailing Birds.

To the Editor of the AERONAUTICAL JOURNAL.

SIR,—I hardly think that Lord Rayleigh can have fully understood Mr. Hargrave's contention when he "fully agreed" with Mr. Maxim that the simple lifting up and down of the air by waves could not, without any onward wind, enable a bird to sustain its weight. It is of no consequence to a bird whether the air within which it is flying is or is not accompanied in its motion by the seawater or by neighbouring air, and if any simple upward

draught of air can enable a bird to support its weight, the upward draught accompanying the back of a wave can do so. No doubt the bird must be falling relatively to the air in which it is moving, and from that point of view it might appear, at first sight, as if it must ultimately reach the water below it which is rising at the same rate as the air. This, however, ignores the forward motion of the bird, which is constantly carrying it over a fresh water surface, which, though moving upwards with the same velocity as the last, began at a lower level, and is, consequently, when the bird reaches it at the same level as the one it has just left, while this latter goes on and does reach, at the crest of the wave, a maybe, higher level than the bird.

It is a mere question as to whether the bird, when moving through the air at the same rate as the waves, will, or will not, fall in still air at the rate of the upward draught on the face of a wave. If a bird gliding downwards at a constant velocity in still air goes forward at the rate of the wave and sinks downwards more slowly than the air at the face of the wave is moving upwards, then it could maintain itself in this upward draught.

It might, at first sight, appear as if the question were the same as the problem as to whether a bird could fly over an undulating country when there was no wind, but the forward motion of the waves, and consequent variable motion of the air over them makes the problem entirely different. If we could assume that there was no tangential force between the water and the air, and it must be quite small, the problem is essentially the same as that of the motion of an undulating country under still air, or what comes to the same thing the motion of air over an unmoving undulating country, and on every hand, by Lord Rayleigh and all other authorities I know of, it is conceded that a bird *can* use the upward draught of air blowing up a hill to sustain itself in a position fixed relatively to the hill. Now suppose the air to be stopped, and the bird and hill given a velocity equal and opposite to that of the air, and we have exactly Mr. Hargrave's case.

The real problem in the case of the bird is probably much more complicated because the motion of the air near the sea is not merely up and down, but is almost certainly, like that of the water, approximately in circles as the wave passes. The bird consequently has not only vertical, but alternating horizontal draughts to depend on, to enable it to sustain itself, so that I have no doubt Mr. Hargrave is quite right in his observation. The only case in which the bird would be unable to use the waves, would be when the wind was blowing at exactly the same rate as the waves were moving forward; that would be the same as if the bird were trying to fly over an undulating country when no wind was blowing. The case would not, however, be *exactly* the same, because there *is* a tangential action between the water and the air, which in the case of the wind blowing at the same rate as the waves would set up eddies, and prevent the lower air from moving as fast as the upper air, and might, in a variety of ways, make it quite possible for those dexterous utilisers of differences of wind motion, the seabirds, to fly without exertion.

I feel the more interested in this question, because from the time of my first taking an interest in Lilienthal's experiments, I have looked forward to the possibility of human beings utilising the trade winds blowing over the sea as a means of locomotion. The irregularity of most winds renders their utilisation by mankind almost hopeless, but the regularity of the trade winds and of the waves they produce makes their utilisation quite possible.

Yours truly,
GEO. FRAS. FITZGERALD.

Trinity College, Dublin,
16th April, 1900.

Count Zeppelin's Air Ship.

While the AERONAUTICAL JOURNAL is in the press, the news of the first trial of Count Zeppelin's Air Ship has arrived, and it is reported that it has travelled from Lake Constance to Immenstadt, a distance of 35 miles, with safety. Any further comment on this fascinating experiment must be held over until the next number of the Journal, when it is hoped that it will be possible to publish a full and reliable account of the initial, and perhaps subsequent, experiments with the greatest air ship ever launched.

NOTES.

The Duration of the Lifting Power of Balloons.— Up to the present, no very methodical scientific investigations have been carried out to ascertain the time that a balloon of a given size can remain in the air without losing its lifting power; and aeronauts who

Digitized by Google

contemplate long-distance ascents estimate the lift of the balloon by mere guesswork. It is probable that Monsieur Andree very much over-estimated the time his balloon would remain in the atmosphere. The balloon is, however, at last beginning to receive the application of scientific methods of enquiry, and a step in the right direction is being made at Berlin, where a joint committee of aeronauts and scientists have collected the means to construct a huge balloon of 318,000 cubic feet capacity. The car of this balloon is 8 feet square and accommodating five persons, sleeping accommodation being provided for three. The principal object of the ascent, which is to take place this summer, is to ascertain the time the balloon will preserve its lifting power, though it is hoped that during the ascent several meteorological and other scientific observations will be taken. It is expected that the journey will last several days, and provisions are to be taken for ten days. The results will certainly be awaited with interest, but the absolute determination of the time a balloon of a given size will remain in the atmosphere must depend very much on the meteorological conditions encountered during the ascent, and would require a prolonged series of observations.

Lady Balloonists.—It is not unlikely that in the future ballooning may become a favourite pastime of ladies. Some, indeed, have already shown signs of an intense thirst to breathe the upper atmosphere. Some years ago, a lady called on the writer of these notes, and asked him if he could give her "lodgings in a balloon," as she wished to ascend every evening. Being an actress on the London Stage, she wished for the stillness of the upper air to recover the nervous exhaustion her public profession exacted. She had also lost her complexion, and thought that nothing would bring it back but the tonic air that is imbibed from a balloon. She had only one fear—that was she suffered from cold feet, and had just a misgiving that the journeys might add to this discomfort. The writer asked her whether she wished to ascend in a free balloon or a captive one, using the word free in its accepted sense in connection with balloons, when she exclaimed "Oh, not in a free one, it would be so crowded." She had an income, and could afford a private one. In the case of this lady, probably enthusiasm was bordering on mental derangement, there are however many examples of ladies of distinguished mental endowment who become aeronauts for the sake of advancing knowledge. In this country, Miss Bacon has won admiration by her courage in sharing the perils of her father's scientific balloon voyages, and has contributed to the usefulness of these expeditions. One of the latest efforts of lady balloonists is that of Miss Klumpke, of the Paris Observatory, who started in a balloon to observe the eclipse of the sun. According to the "Daily Telegraph," Miss Klumpke failed to accomplish the observation she intended to make. It appears she started too late, barely an hour before the commencement of the eclipse, and did not rise sufficiently high above the clouds to be able to make observations of the corona. The elevation reached was only three and a half kilometres, whereas Miss Klumpke has come to the conclusion that balloon observations of solar phenomena will generally require a height of five kilometres. At this altitude, Miss Klumpke thinks that it will be an easy matter to obtain photographs of the sun of great scientific value. But though the main object of these ascents was not realised, yet, it appears, that some valuable meteorological data were obtained. The Duchess d'Uzes is also an ardent balloonist, though in her case, it appears to be the pleasure of the aerial voyage that attracts her, and not scientific investigation. She has lately taken a three hours' trip in a stiff breeze, piloted by M. Mallett. The start was made from Saint Denis, and the landing safely accomplished at Montargis.

The Paris Balloon Races.—According to the "Morning Herald," the recent long distance balloon races has been successfully accomplished. It was won by M. Balsan, in his balloon Saint Louis. The aeronaut had remained 18½ hours in the air without descending. M. Jacques Faure came in second, with 17 hours. This race, however, does not run the record at all close, since M. Castillon St. Victor has still the record of 29 hours.

The Descent of a French Balloon and Kite in England.—One of the French unmanned balloons with self-recording instruments fell on May 9th into a tree on the farm of Mr. Horton, Little Leigh, near Northwich, Cheshire. In the basket containing the recording instruments, letters were found from a French observatory, offering a reward for any person finding and dispatching the instrument to the owners.

Mr. E. Ibbotson recently addressed a letter to the "Standard," describing the fall of a large French kite in a field at Burmarsh, Kent, about a mile and a half from the sea, during the gale of February 10th. The kite was three feet wide and nine feet long, and had about three hundred yards of tail attached to it.

Digitized by Google

The rector of the parish at once communicated with the owner, and obtained the following information. The kite broke adrift from the grounds of M. Delcourt, Chalet des Vogues, Pas de Calais, at six p.m. on February 10th. A shepherd who was looking after his sheep came to the end of the cord which he picked up and began to wind up; after a long while he arrived at a ditch, in which lay the kite. The cord was lying in a S.W. to N.E. direction, and had been trailed through the sea, and over the telegraph wires which run along the sea coast. The kite was packed and returned to the owners, who not only paid all the expenses incurred, but liberally rewarded the finder.

War Balloons and International Law.—A legal correspondent in the "Standard," recently commented upon the debated question as to whether the war balloonist, when captured, is liable to be court martialled or captured and shot as a spy, or should be treated as a prisoner of war. Germany has been the chief exponent of the sterner view. In the Franco-Prussian War, M. Verrecke and some other balloonists who descended in Bavaria, and were taken captive, were sent to a military prison. M. Nobecourt, made captive under similar circumstances, was condemned to death, although the sentence was afterwards commuted to one of fortress imprisonment. In no case does the extreme sentence appear to have been carried out on a balloonist. The more lenient, and surely reasonable view is represented by Article 22 of the Brussels Declaration of 1874, which provides that "individuals sent in balloons to carry despatches, and generally to keep up communication between the different parts of an army, or of a territory," are equally with military men charged with the duty of penetrating the enemy's lines to collect information, entitled to be treated, on capture, as prisoners of war.

Obituary.

MONSIEUR DAGRON.

"La Nature" informs us of the death of M. Dagron, an aeronaut of the siege of Paris, and the inventor of the microscopic photography. This ingenious process added considerably to the usefulness of the aerial post during the investment of the French capital. The tiny scraps of paper on which the correspondence was photographed, was so exceedingly light, that one pigeon used to carry over fifty thousand messages, which were read off at the post office, by means of an optical projection apparatus. It is a fact that the fifteen hundred thousand messages sent during the siege, could have been carried at once by one bird. M. Dagron was born at Beauvoir, and attained the age of eighty-one. As "La Nature" remarks, his name deserves to be remembered.

Foreign Aeronautical Periodicals.

L'AERONAUTE (Paris).

April.—Séances des 5 Mars. et 5 Avril. Communication par M .F. Roux, "Le Vol des Oiseaux Explique."

May—Séances des 19 Avril and 3 Mai.—Discours par M. Eric Stuart Bruce. — Communication par M. Grimoin Sanson, ingénieur du Cinéorama à l'Exposition.—Nécrologie.—Madame Vve. Hureau de Villeneuve.

LA FRANCE AERIENNE.

1—15 *April.*—Exposition Universelle de 1900.—Réglement des Concours Nationaux de Colombophilie.—Le présent: C. Jobert.—Aérostation, Exposition Universelle de 1900.—La Colombophilie Algérienne: E. Caillé.—Exposition Annuelle des Avicultures Français: M. Dagour.—Colombophilie Militaire: E. Caillé.

15—30 *April.*—Aeronautique Rétrospective: Docteur Ox.—Combattons La Nature.—Un Progrès en Colombophilie: E. Caillé.—Tribune Libre: A propos du Grand Prix de l'Aéro-Club.—Partie Littéraire.—Le Pigeon de Coulmiers.

1—15 *Mai.*—L'Aéronautique au jour le jour.—Pléthore d'Experimentations.—Ballon Dirigeable et Poisson.—A propos du dernier accident survenu aux Ateliers de Meudon: C. Jobert.—La Colombophilie au jour.—Notre élevage en 1900: E. Caillé.

15—31 May.—La Colombophilie au pays des Tzars: Docteur Ox. Le Point d'Appui.—La France Aérienne en Normandie: Réunion Solennelle de la Fédération à Rouen. Revue de Presse Etrangère.—Avril, 1900, Aeronautical Journal.—Mme. C. Jobert.

1 au 15 *Juin.*—Le Vent.—Comte Jules Carelli.—Une Fête in time.—La France Aérienne à l'Etranger.

L'AEROPHILE (Paris).

April.—Portraits d'Aéronautes Contem-

Digitized by Google

poraines: Comte Jules Carelli (Wilfrid de Fonvielle); Petite Expérience de Ballon Dirigeable (Comte Straus); L'Aérostation et la Comte Portale illustrée (Emile Straus); Commission Aéronautique Internationale (A. Nicolleau); Etudes sur l'Electricite Atmospherique (A. Cléry).

ILLUSTRIRTE AERONAUTISCHE MITTHEILUNGEN (Strassburg).

Ballon photogrammetrie: K. V. Bassus. Aëronautik.—Verbesserungen au der Ballonzerreissvossichtung: Ernst Hauptmann.—Die Aussichten Leutbarer Ballons: Hauptmann Hermann Hoernes.—Ein neuer Abwurfhaken für Registrirballons: Prof. Dr. H. Hergesell.—Graf von Zeppelin's Luftschiff.—Englische Luftschiffer.—Abtheilungen un Süd Afrikanischen Kriege.—Die Beziehungen Zwischen Meteorologie und Luftschiffahrt. Todtenschaus-Gotelieb Wilhelm Daimler: Henry Coxwell.

Notable Articles.

April 4. *Manchester Guardian.*—"Aerial Locomotion." Lecture by Mr. HENRY WILDE.

6. *Public Opinion.*—"Dangers to Balloons."

19. *Sphere.*—"New Form of War Balloon."

May 4. *English Mechanic.*—"The Subjugation of the Air." Letter by E. WILSON.

5. *Golden Penny.*—"Remarkable Flying Machine."

Admiralty and Horse Guards Gazette.—Notice of Article on "Military Ballooning" in the *Militär Wachenblatt.*

11. *Globe.*—"Is Andrée Alive?" Views of Mr. PERCIVAL SPENCER.

May 11. *Westminster Gazette.*—"War Balloons at the Front:" A Talk with Mr. A B. Delmard.

June 1. *Golden Penny.*—"Dropping from a Balloon."

McClure's Magazine.—"Experiments in Flying." (Illustrated.) By O. CHANUTE.

2. *Pall Mall Gazette.*—"Coming Trial of a Navigable Balloon."

The following List of Applications for Patents connected with Aeronautics has been specially compiled for the *Aeronautical Journal* by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.:—

Applications for Patents.

(*From 7th March to 30th May*, 1900.)

7,442 of 1899. D. M. BOWYER-SMITH, 20, Piccadilly, London. **Improvements in or Relating to Propelling Means Suitable for Use in Flying Machines.**

7,635 of 1899. AUGUST RIEDINGER, 23, Eisenhammerstrasse, Augsburg. **Improvements in Captive Balloons.**

14,802 of 1899. G. LOEPER, 27, Metzer Strasse, Berlin. **Improvements in Navigable Balloons.**

24,047 of 1899. A. J. BOULT, 111, Hatton Garden, London. **Improvements in or Relating to Air Ships or Vessels.** (Communicated by Ernst Rudolf Krocker, merchant of Teplitz, Bohemia).

5,092. P. A. ALEXANDER, of the Experimental Works, Bath. **Improvements in or connected with Air Propellers.**

Digitized by Google

ENGINEERING LIBRARY
620.5
A245

ENTERED AT STATIONERS' HALL.] PRICE, TO NON-MEMBERS, 1s.

UNIV. OF MICH.
AUG 4

THE AERONAUTICAL JOURNAL



Edited for the Council of the Aeronautical Society of Great Britain
By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 16. OCTOBER, 1900. VOL. IV.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	143
THE RESIGNATION OF MAJOR BADEN-POWELL FROM THE HONORARY SECRETARYSHIP OF THE AERONAUTICAL SOCIETY	143
GENERAL MEETING OF THE AERONAUTICAL SOCIETY	144
1. THE ZEPPELIN AIR SHIP. By HIRAM STEVENS MAXIM	144
2. CLOUD PHOTOGRAPHY FROM BALLOON. By the Rev. J. M. BACON, F.R.A.S.	146
3. PORTABLE ELECTRIC BALLOON SIGNALLING IN WAR. By ERIC STUART BRUCE, M.A. Oxon., F.R.Met.Soc.	148
4. THE WECZERA FLYING MACHINE. By L. W. BROADWELL	150
5. DR. DANILEWSKY'S FLYING MACHINE. By Dr. K. DANILEWSKY —DISCUSSION	151
AERONAUTICS IN 1900	153
MONSIEUR JACQUES FAURE'S BALLOON VOYAGE ACROSS THE CHANNEL—LETTER FROM MONSIEUR FAURE TRANSLATED BY HELEN AUXILIUM BRUCE	155
THE RECENT HIGH KITE ASCENTS AT THE BLUE HILL OBSERVATORY. COMMUNICATED BY MR. LAWRENCE ROTCH	156
THE PARIS INTERNATIONAL AERONAUTICAL CONGRESS	156
THE LIFTING POWER OF AIR PROPELLERS. By WILLIAM GEORGE WALKER, A.M.I.C.E., M.I.M.E.	156
NOTES: THE BALLOON ASCENT FROM THE TOP OF THE RIGHI—WIRELESS TELEGRAPHY EXPERIMENTS FROM A BALLOON—FATAL BALLOON ACCIDENT AT NAPLES—M. ROSE'S AIR SHIP—THE PARIS BALLOON CONTESTS —M. SANTOS DUMONT'S MOTOR BALLOON—THE PARIS EXHIBITION AWARDS	162
FOREIGN AERONAUTICAL PERIODICALS	163
NOTABLE ARTICLES	164
APPLICATIONS FOR PATENTS—PATENTS PUBLISHED	165

LONDON:
PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., GOUGH SQUARE AND BOLT COURT, E.C.

Digitized by Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer,

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers,

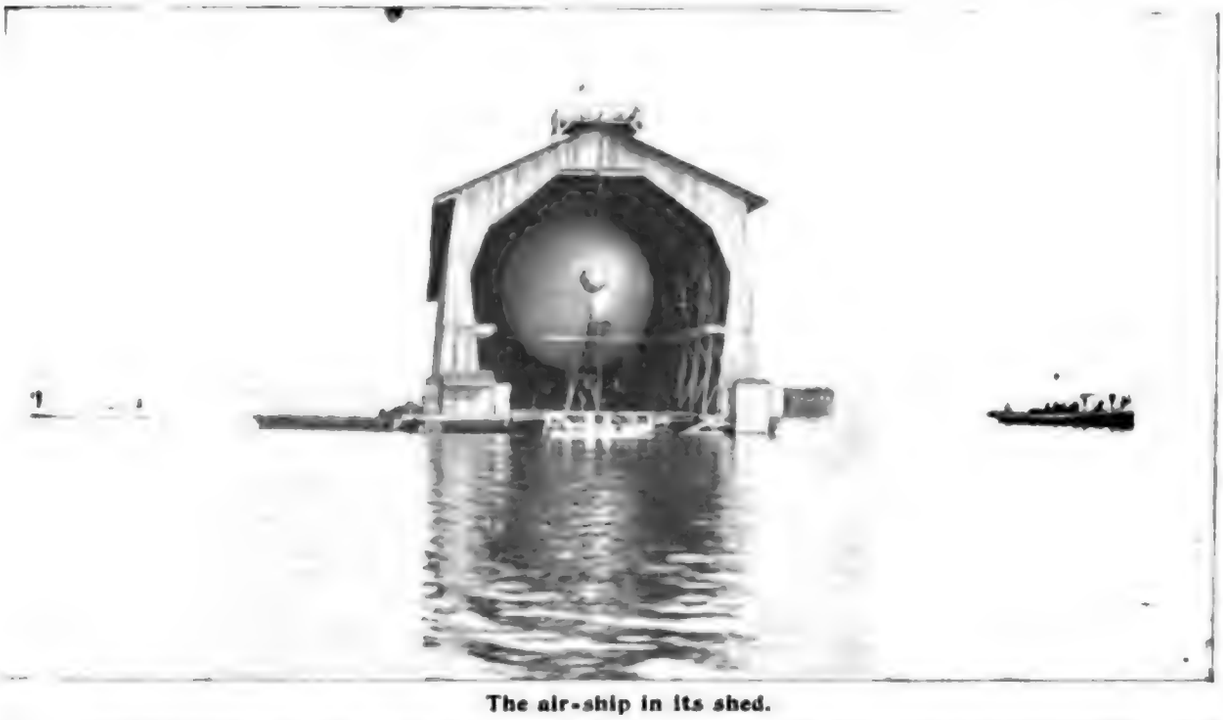
Messrs. KING, SELL, & RAILTON, 4, BOLT COURT, LONDON, E.C.

Digitized by Google

THE ZEPPELIN AIR-SHIP.



The air-ship on its voyage, July 2nd, 1900.



The air-ship in its shed.



The air-ship just emerging from the shed.

The above illustrations are from Pearson's Magazine, by kind permission of the Editor.

Digitized by Google

THE AERONAUTICAL JOURNAL.

OCTOBER, 1900.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor, 19, Campden House Road, Kensington, London, W.

NOTICES OF The Aeronautical Society.

A meeting of the Council was held on July 17th, at the Society of Arts, when the following gentlemen were elected Members of the Society :—

MR. CHARLES GROOMBRIDGE.

MONSIEUR EUGEN SVERTCHKOFF.

Read letter, dated June 17th, from Mafeking, from Major B. F. S. Baden-Powell resigning the post of Honorary Secretary of the Aeronautical Society.

RESOLVED—

The Council, whilst accepting with regret the resignation, take this opportunity of recording the very valuable services rendered by him to the Society, which he virtually re-established from the time he accepted the Honorary Secretaryship, and especially by his inaugurating the new quarterly "Aeronautical Journal."

Proposed by MR. E. P. FROST,

Seconded by MR. HIRAM MAXIM,

That Major Baden-Powell be elected as President of the Aeronautical Society of Great Britain.

Carried unanimously.

Proposed—That Mr. Eric Stuart Bruce be invited to accept the post of Honorary Secretary of the Aeronautical Society of Great Britain, in place of Major B. F. S. Baden-Powell resigned.

Carried unanimously.

ERIC STUART BRUCE,
Honorary Secretary.

It is found necessary to call the attention of members and others to Rule 45, which states that "Every paper which may be presented to the Society shall, in consequence of such presentation, be considered as the property of the Society, unless there shall have been any previous engagement with its author to the contrary; and the Council may publish the same in any way, and at any time, they may think proper. But should the Council refuse or neglect, within a year, to publish such paper, the author shall have a right to copy the same, and publish it under his own directions. No other person, however, shall publish any paper belonging to the Society without the previous consent of the Council."

As it will be noticed that the words "All rights reserved" appear for the first time on the current number of the "Aeronautical Journal," the Editor wishes to explain that this notice is not intended to divert criticism of its contents or legitimate quotations from its columns, but merely to maintain Rule 45 quoted above, valuable papers, which are the property of the Aeronautical Society, having recently been copied in their entirety from the Journal without the consent of the Council.

The Resignation of Major Baden-Powell from the Honorary Secretaryship of the Aeronautical Society.

As will be seen by the published Minutes of the Council Meeting of the Aeronautical Society of July 17th, Major Baden-Powell has resigned the Honorary Secretaryship of the Society. This news will be received with regret not only by the members of the Society, but by all those in this country or abroad, who have had the privilege of intercourse and correspondence with him, and who have appreciated his ever readiness to give information or advice on those aerial subjects to which he has devoted so much of his energies. But the term of his Secretaryship has been sufficiently long to place the Aeronautical Society of Great Britain on a secure and lasting basis, and the Presidency of the Society, which has been accorded him, is an honour that is well won.

The scientific world lately received with the most intense satisfaction the news that Sir William Crookes, that most illustrious Member of the Council of the Aeronautical Society, had accepted the Honorary Secretaryship of the Royal Institution. It is needless to state how brilliant, profuse, and far-reaching have been the discoveries of this profound searcher after truth. Many of them are reflected in the applications of science to the wants of daily life, such as the familiar incandescent lamp made possible by the professor's researches in high vacuas, while "the Crookes Tube," as the vital necessity of the Rontgen radiation, has added well-nigh infinite resources to the practice of modern surgery. As was stated by a high scientific authority on the occasion of the jubilee of the Royal Institution, there is probably no institution in the world that has extended science so much as has the Royal Institution, and it rests indeed on solid foundations of prestige. But the happy choice of its present Honorary Secretary is destined to add a new lustre to its proceedings, and enhance its world-wide fame.

Major Baden-Powell has been appointed by General Paget, Railway Staff Officer at Warm baths, Transvaal.

Mr. Eric Stuart Bruce, the Honorary Secretary of the Aeronautical Society of Great Britain, has been elected Membre d'Honneur of the Paris Aero-Club.

The Aeronautical Society of Great Britain.

An ordinary meeting of the Aeronautical Society was held at the Society of Arts, John Street, Adelphi, on Tuesday, July 17th, 1900. Major H. C. Roberts occupied the chair.

The CHAIRMAN: Ladies and Gentlemen,—I have to inform you that the reason of the delay in calling this meeting was partly on account of the absence of our Honorary Secretary, Major Baden-Powell, whom we had hoped at one time would have been able to be present at this meeting. We must, however, look forward to seeing him at a future time. There was also another reason for the delay, because our Honorary Secretary, Mr. Eric Bruce, has been over in Paris addressing the meeting of the Aeronautical Society there. He has been there for many weeks, and has written out for our satisfaction a brief essay of what he read there. I shall not detain you any further, because we have a long meeting before us, and I will now ask Mr. Bruce to say a few words.

MR. ERIC STUART BRUCE: I have to announce to the meeting of this Society to-night, news that I have just received from Major Baden-Powell, dated June 17th, Mafeking. In the letter which he has addressed to me he says that he wishes to send in his resignation as the Honorary Secretary of this Society. I feel sure that all the members of the Society receive this news with very great regret. I do not think that any Secretary of any Society has ever done so much in so short a time as Major Baden-Powell has done for the Aeronautical Society of Great Britain. It is not exaggerating the truth when I say that the Aeronautical Society of Great Britain holds as important a position in the scientific world as any scientific society in this metropolis. Therefore, I think we shall all regret his absence as Honorary Secretary, and I am afraid it will be a secretaryship that will never be replaced.

The CHAIRMAN: I beg to announce, ladies and gentlemen, that since we received this letter from Major Baden-Powell resigning the post of Honorary Secretary, we have in Council Meeting passed unanimously a proposition that he be elected as President of the Society. This, I think, will be very gratifying to all of us, especially when we know the trouble he has taken in carrying on the affairs of the Society for so long a time. We have next to call upon Mr. Hiram Maxim, who will read a paper on the subject of the Balloon Experiments carried out by Count Zeppelin in the airship of which we have seen some account in the papers.

THE ZEPPELIN AIRSHIP.

By HIRAM STEVENS MAXIM.

I have been asked to give my opinion in regard to the value of the experiments of Count Zeppelin. I have made a close study of balloons for many years, and have followed very closely the experiments of Gaston Tissandier and Commandant Renard. In the experiments of Gaston Tissandier, the balloon was made cigar-shape, both ends being practically alike. The propelling force was a screw driven by an electrical engine. The machine was very carefully made, and was probably as beautiful a piece of workmanship as ever has been turned out. It was inflated with pure hydrogen. When it was tried, it rose in the air to perfection, and moved at a low velocity by means of its own screw and motive power, but the velocity through the air was considerably less than the velocity of the air itself, consequently it moved along with the wind very much like any other balloon. Other experiments were made, and it was found that the cigar-shape was not so favourable as a fish-shape balloon. Captain Renard constructed several balloons, the greater part of which were fish-shape, that is, full forward, and slim

and tapering aft. In these balloons, the very best accumulators and electrical engines were employed for propelling a screw of large diameter that was used. On one occasion in a dead calm, the balloon ascended, travelled some three or four miles, and returned to the point of departure. It was drawn down by ropes and put back into the shed, where it had been built, and this is, I believe, the only instance in the history of the world where a balloon has returned to the point of departure.

Many other experiments have been made by Captain Renard, who is, as is well known, employed by the French Government, and who has unlimited means and assistance at his disposal.

But in no case, except in the one just mentioned, has he succeeded in making his balloons return to the point of departure. It was told me by one of his assistants that the balloons only travelled about four miles an hour, and as the wind always blows a little more than four miles an hour, they were sure to travel with the wind exactly as all other balloons had done before.

In regard to the recent experiments of Count Zeppelin, it appears that a very large and expensive balloon was constructed. To prevent all the gas from getting into one end of its elongated form, as often happens, a considerable number of compartments were employed, each of which was filled with hydrogen gas. Instead of using an electrical engine, as had been employed in France, he used a much stronger and lighter motor, viz., a petroleum engine. The French, whilst acknowledging that a petroleum engine developed more power for its weight than could be done by electricity, appeared to be afraid to employ it on account of the great liability of igniting the gas in the balloon.

In the first accounts of these German experiments, it was said that the balloon travelled 30 miles. We then hear that it travelled about three miles, and was finally towed back to the shed where it had been built. As all the information I have at hand is based on newspaper reports, and no two of these are alike, I do not feel that I have sufficient reliable data by me to draw any conclusions. I would, however, say that it appears to me quite useless to endeavour to make a balloon that would travel against the wind. A balloon, in the very nature of things, has to be lighter than the same volume of air. Its density is therefore very small. In order to be of sufficient size to lift itself, and any considerable load, it necessarily has to be of great dimensions, and being of great dimensions, and, as one might say, very soft and fragile, it cannot be made to travel against the wind. As before stated, balloons always have travelled with the wind, and it appears that this new German balloon is no exception to the rule. The experiments of Professor Langley, Mr. Horatio Phillips, and myself have been sufficiently successful to demonstrate that not only great lifting effect but also propelling effect may be obtained by the use of aeroplanes and screws, that is, with true flying machines—machines heavier than the air. But these experiments are extremely expensive, and require a great deal of time. Flying machines are sure to come in the immediate future. We certainly have enough skill in England to build one. I think the same may be said of the United States of America. In France, however, although they may have no more skill than we have, the abundance of money which they have at their disposal gives them a great advantage.

In regard to the use of flying machines, there can be no question but what at first they will be rather risky things to play with. Their primary use will be for warfare. I think I may say that the danger of navigating such a machine and of reconnoitring an enemy's position will not be greater than any other form of reconnoitring—in fact, I should say it would be infinitely less. I think flying machines would also be of great value for conveying despatches over difficult country in time of war, to say nothing of occasionally dropping a bomb into the place where it would do the most good.

Flying machines, like automatic guns, make war more difficult and expensive. They will give to the highly civilised nation, which has both money and engineering skill, great advantages over poorer and less skilful nations, which will, of course, be a potent factor in extending the borders of civilisation, or, as one might almost say, of civilising the world.

The CHAIRMAN: Does anyone wish to ask any questions, or to say anything about this Zeppelin Flying Machine? If so, will they do so at once.

MR. ALEXANDER: Ladies and Gentlemen,—As one of the assistants and observers of this balloon, I consider after 20 years of anxious thought and time in experimenting, the experiment so far as it went was a success. We got the balloon out of the balloon-house about 7.30 in the evening, and about 8 o'clock we got it up into the air. Its stability was maintained, and after we got the engines to work we got along at the rate of 18 miles an hour. It was not for long, I regret, because the

steering gear was carried away and one of the special rudders became unmanageable; we lost control of the machine, and we had to come down. That is the result of the experiment in as few words as I can put it.

Mr. Alexander (in reply to a question as to the distance the balloon travelled): 3.5 miles. It was telegraphed, and I suppose someone left out the decimal point and it was put down as 35 miles.

Mr. Alexander (in reply to a question as to whether the balloon travelled with or against the wind): Against the wind. Lieut. Hildebrande took the speed of the wind. The balloon went with the wind for a few moments until we got the engines to work, and then it went against the wind, and then our steering gear gave way. I should like to lay emphasis on this point; that the stability of the balloon, which was 420 feet long, was perfect, and as far as the experiment was concerned it was very good indeed.

Member (name missed): I am sure it must be highly gratifying that we have heard the first authentic account in this room of one of the most remarkable experiments made in balloons. But could the gentleman translate the speed of the wind and the speed of the balloon into terms that one can understand. How much did the speed of the balloon exceed the speed of the wind? That is, against what speed of wind did the balloon travel and how quickly? It is the difference of course. It was going against the wind, and it is the difference between the speed of the balloon and the speed of the wind.

Mr. Alexander: The wind was blowing I should say about 16 miles an hour, and the balloon was going about two miles an hour. I have a lot of pictures and papers with details of the balloon here, and if anyone would care to see them, I shall be glad to show them; and I also have the chart here of the track of the balloon. I might say, too, that in this morning's "Leader," there are copies of the photographs which are quite true.

The Chairman: I am sure, ladies and gentlemen, that you will accord a vote of thanks to Mr. Maxim and to these gentlemen who have spoken on the subject of his notes. I will now ask the Rev. J. M. Bacon to illustrate by photographic lantern slides his "Cloud Photography from Balloons."

The Rev. J. M. Bacon: Mr. Chairman, Ladies and Gentlemen,—I must ask your indulgence with regard to these photographs, for they are somewhat hastily done. That has been a matter of necessity because I have been out of the country hunting the track of the eclipse in the southern States of America. Having once got into that country, I could not come back in a hurry, and I only left myself a very few days to produce the necessary slides to illustrate the short paper which I have put together.

CLOUD PHOTOGRAPHY FROM BALLOONS.

By the Rev. J. M. Bacon, F.R.A.S.

The aeronaut can scarcely turn his camera to better account than in the pursuit of cloud photography. Snap-shots of objects on the earth taken from short range overhead are generally more curious than interesting, and extended views from greater heights, however impressive to the observer, seldom make satisfactory photographs, not only through lack of detail, but owing also to the haze that too often veils the landscape at the height—say of 1,000 ft. and upwards. Speaking generally, through the greater part of any balloon voyage worthy of the name, successful views of the country are out of the question. On the other hand, on days that are not altogether cloudless, there is often opportunity at nearly all heights for interesting and valuable work in photographing all features of the cloudscape, from the mere withering cloudlet that wanders by to the piles and masses of dense cloud that make up the scenery of a full sky.

There are occasions, especially in early afternoons in summer, when there may appear no prospect whatever of any cloud photography. The sky may have been clear since early morning, and at the hour of starting usual in public balloon ascents, conditions as far as they can be judged of on the ground, seem all unchanged; yet the aeronaut may have the happy chance before the day's work is done, at some moment altogether unexpected, of securing some photograph of real value. Columns of warm moist air, however slender, are commonly ascending as the afternoon advances, and at almost any altitude a level may be reached, which is at the condensation point of the ascending vapour, when a cloud-wreath will inevitably form, even though its fate is to waste away again almost immediately.

Such cloud-wreaths may be almost imperceptible to an observer below. I have a note and also a photograph of an occasion, when, at about 1,000 ft. over the Crystal Palace, we were unexpectedly enveloped in a palpable cloud that utterly blotted out the Palace grounds; yet spectators in the grounds saw us all the while veiled only in what seemed to them the filmiest vapour. Directly after, the

cloud passed by us and we caught a ghost of a shadow of our balloon. This shadow in its entirety with its prismatic rings and complete outline—which must be perfectly familiar to my audience, most of whom, doubtless, like myself, have seen it in sunlight and also at night under a full moon—I have never succeeded in photographing satisfactorily. As illustrated in Mr. Glaisher's well-known volume it is to me exaggerated.

These anthelia seem common enough in Alpine regions and Polar seas, and it may only be necessary for the observer to be so located as to have the shadow of his head thrown by sunlight on to adjacent cloud, indeed, it is asserted that virtually the phenomenon, due simply to diffraction, is to be seen when a low sun throws the shadow of an observer's head on to grass heavy with dew. I submit, however, that if a certain amount of low temperature is not essential, at least *texture* of cloud has much to do with the number, vividness, and also chromatism of the rings.

This quality of cloud certainly would have everything to do with the sharpness of outline of a balloon shadow, and I would like to ask aeronauts present if they have ever seen a balloon shadow quite so substantial looking as one figured in Mr. Glaisher's book. I myself have not. I would also like to ask if others share an impression gathered by my companions and myself—that the balloon shadow seen coursing over the ground is more distinct under a bright moon than in daytime.

I had a rather exceptional opportunity of making an unbroken series of cloud observations during an aerial ride lasting nearly ten hours, in November last. The voyage was instructive throughout. We left the earth a little after 4 a.m. on Nov. 16, with a gentle wind from the east, the lower air being somewhat chill and dry. The sky was perfectly clear up to 1,500 ft., at which height we suddenly entered a dense cloud canopy which was comparatively warm and extraordinarily wetting. So extreme was the condensation of moisture on the balloon from this fog, that more than 3 cwt. of ballast had rapidly to be parted with to enable us to penetrate it, and to maintain ourselves in the clear air above its upper margin. We have all been made familiar with the great differences of humidity noticeable in different kinds of fogs. The densest London yellow fog is generally a dry fog. The ragged fringe of a nimbus cloud on the contrary may be all moisture, while the aeronaut, all in a brief interval and in the space of only a few thousand feet, may experience in cloud every grade of humidity. One record of an ascent of Mr. Glaisher's runs thus:—At two miles he encounters fog which a little higher becomes rain. Passing out of this he enters dry fog at 12,000 ft., and shortly after reaches a wetting fog. At 15,000 ft., the fog is less wetting. At 16,000 ft., it is dry; but at 18,000 ft., he is in wetting fog once more.

At 5.20 a.m. during the voyage I am referring to, having risen to 4,000 ft., I took the temperature carefully with a sling thermometer, and found it 42°, but half an hour later, having dropped a thousand feet, the temperature had fallen four degrees. We were, now, however, on the actual upper margin of the cloud stratum where evaporation was going on very rapidly. As soon as light became strong enough all around us, wreaths and billows of mist were seen rising and vanishing into the clear dry air by a wholesale process of evaporation on such a giant scale that it is hard to understand how the cloud stratum maintained its mass and density for so many hours as it did unless it was constantly re-forming at a lower level. The photograph shown here represents the cloud as it appeared from a point about 2,000 ft. above its upper surface.

After this the sun asserted itself and drying off the moisture on the balloon, and warming the gas, we mounted up 1,000 ft. in every twenty minutes, and soon were looking down on the same cloud floor from an elevation of 9,200 ft.

I would point out two facts in this photograph (1) how smooth the surface now appears, and (2) what a dazzling flood of light is everywhere, giving a picture much over-exposed although taken with the quickest shutter.

As to the observed upper surface, the smoothness noticeable is certainly more apparent than real. We are now regarding it from a distance of a mile overhead, and we know, from the photograph last shown, that when seen from 1,000 or 2,000 ft., its texture is really broken and ragged. It is surely the same with the characteristic flat-bottomed cumulus clouds. When approached in a balloon the effect of the smoothed off under surface is lost and cannot be shown in a photograph.

Before dismissing the present slide I will ask attention to the overpowering light that floods the picture. We voyagers might well have been visited with snow blindness, and I can fully enter into an experience recorded by Mr. Glaisher. He had ascended on a rainy

day late in July when cloud was lying at all heights; but at 12,000 ft. he passed out of rain and overlooked a range of surrounding clouds so dazzlingly white that it was with difficulty he could read the instruments furnished with ivory scales.

After hours of a protracted voyage, having apparently encountered some cold blast blowing over the estuary of Severn, our balloon was spontaneously but very slowly creeping downwards, and at about 1 p.m. we were once more about 2,000 ft. above the cloud floor: but observe the difference. It is now breaking up into hollows under the hot sun. In other ways, too, its condition seemed different. We were expecting, not to say hoping, that as soon as we dipped into the upper fringe of cloud, the balloon, over which we had lost control, would become chilled and so descend more rapidly, but for a length of time this was not so, the fringe that had struck so chill at day-break was now only a warm vapour bath.

It is instructive to compare such clouds as we have been looking at at close quarters in the free heavens with others seen equally at close quarters, but contiguous to earth and at different elevations. We have here: (1) Mist over a river valley. (2) Cloud on a snow mountain. (3) Clouds surmounting a snow mountain. (Photograph shown.)

On the mountain side we doubtless get not a permanent cloud but rather mist that is being constantly dissipated and as constantly reformed.

The permanent cloud becomes clearly more compacted, especially so when under electrical tension as in the thunder pack or hailstorm cloud.

The formation of a flat-bottomed cloud was witnessed and figured by Mr. Whymper under peculiar circumstances. The strikingly flat-bottomed cloud is, in my experience, most pronounced when such cloud rests on a lower current blowing from the east.

It is found that atmospheric conditions greatly aid the work of the camera.

I have always conceived a distinction in the aspect of clouds over different portions of the globe, it being a well known fact, referred to by Nansen, and others, that the sky reflects the general tone of the country beneath.

Here is a photograph of the upper limit of a typical summer evening cloud. (Photograph shown.)

One last photograph taken in the fringe of cloud where the picture seemed hopeless from the veil of mist; but like the astronomer, finds a slight haze aid definition in an over-brilliant object like the moon, so, I imagine, the cloud fringe aided a picture which the near presence of water surface might otherwise have made over-exposed. (Photograph shown.)

The story was simply this.

The CHAIRMAN: Ladies and Gentlemen,—I am sure we are all much indebted to the Rev. Mr. Bacon for his very interesting paper and for these beautiful illustrations of it. If anyone wishes to ask him any questions, I am sure he will be happy to reply to them. At the same time I may mention that we have a longish programme before us and that we must get on as fast as we can.

The REV. J. M. BACON (in reply to a question whether the photographs were all snapshots): All entirely snapshots, except those reproduced from books.

The CHAIRMAN: The next paper that we have before us is on "Portable Electric Balloon Signalling in War," illustrated by lantern views, working models and experiments. I ask Mr. Bruce to give us his paper.

PORTABLE ELECTRIC BALLOON SIGNALLING IN WAR.

By ERIC STUART BRUCE, M.A. Oxon., F.R. Met. Soc.

Thirteen years ago, shortly after I had been privileged to supply the British Government with my Electric Signalling Balloon Apparatus, I showed upon the screen of the London Institution the same picture that is now before you. It represents the signallers of two friendly military forces shut in by high mountains. It shows how limited is the usefulness of the ordinary methods of visual signalling, which depend upon some vantage point for altitude; it shows how valuable in such a case is the electric signalling balloon. In the picture, the signallers on this side of the mountain are filling the balloon with gas for the ascent. On the other side, the balloon has already ascended. In the next picture both balloons have ascended to a considerable elevation, and the signallers are independent of the configuration of the country. I will now ask whether this picture does not partly represent the conditions realised so often during the South African Campaign, when our brave soldiers have been imprisoned so long amidst the rugged mountains of Natal, and where failure of communication has been the cause of disasters. But when I point out cases when the use of electric balloon signalling would be invaluable, I am not suggesting any negligence of the War Office or of those officials who are responsible for the efficiency of means of com-

munication. In fact, the utility of this system of balloon signalling has received acknowledgment from our Government experts, and the apparatus has been supplied to the Balloon Section of the British Army; forming part of the balloon equipment. And doubtless, in places such as Ladysmith, where the military observation balloon has been used, it has proved useful. The object of this paper is to suggest an increased usefulness of the system by the introduction of a still more portable form of the apparatus, which can be placed into the Signalling Department of the Army, as well as the Balloon Department, and which, from its mobility, can be taken into places and positions which are inaccessible to transport waggons. The principle of electric balloon signalling is now well known to the members of this Society. Inside a balloon of translucent material are placed several incandescent electric lamps. These are in metallic circuit with a source of electricity on the ground. In the circuit is placed an apparatus for making and breaking contact rapidly. By varying the duration of the flashes of light in the balloon by long or short depressions of the signalling key it is possible to signal sentences. On the screen I throw the image of a translucent balloon and simulate the method of signalling. I only flash one word "Baden Powell" (experiment shown).

Compared with an ordinary balloon transport, I have always described my signalling balloon as portable. Before you, is a picture of a signalling balloon of 18 feet diameter taken at the Cork Military Tournament. This had a gas capacity of some 3,000 cubic feet, and it required about 30 tubes of compressed hydrogen to fill it, each tube being about eight feet long, five inches diameter, and weighing 70 lbs. But the exigencies of the present campaign has led me to devise a portable emergency balloon which can go wherever the signallers can go and yet will supply the means of obtaining a considerable degree of altitude for the signals.

To accomplish this, I have approached the impossible as far as I have dared, and in some parts of the apparatus strength and durability have had to be sacrificed to lightness. However, if a whole battalion can be saved by the use of an emergency balloon, this sacrifice would be justified even if the balloon could only be used once or twice. This, however, would not be the case, as such a balloon could be used a number of times.

To obtain lightness of the balloon I employ goldbeaters' skin instead of varnished cambric, the material of which my larger signalling balloons have been made. To raise a cambric balloon from the ground with coal gas would require a balloon of some 10 feet diameter, but a goldbeaters' skin balloon need only be a few inches in diameter to raise itself. On the screen is a fine example of a goldbeaters' skin balloon — the military observation balloon of the British Army—the most perfect observation war balloon in the world. Here we have a substantial structure in which layer upon layer of goldbeaters' skin is combined. In the case of the signalling balloon, for the sake of translucency, we must be content with three or four layers. Then the metal aluminium, the density of which is only 20.6 helps us to obtain our portable signalling balloon, for we can make the ladder frame on which our lamps are suspended of this material. To exemplify the gain for lightness, where a balloon is concerned, I hang a copper wire ring on this little balloon and it acts as a drag on its lifting power. The balloon does not rise. I substitute for it aluminium of the same size, and the balloon ascends (experiments shown).

Mobility is also afforded by improvements in storage batteries which have rendered them very portable. These two batteries contain six cells in each, and I will show how brilliant a light it is possible to get with these two portable batteries. I flash this incandescent lamp by means of my carbon contact signalling key. Such a battery as this would supply power for intermittent signalling for some weeks. It may be said that occasions might arise when batteries could not be renewed. In such cases I should propose a portable hand dynamo. From this table dynamo I can produce an electric light, and a little exaggeration of this arrangement would provide us with a source of electric power. I reckon that the smallest possible signalling balloon to be efficient would be a goldbeaters' skin balloon of seven feet diameter. This would lift a very light cable and one lamp a few hundred feet, and only require two gas tubes 120 cubic feet capacity for its inflation. A better size giving a more useful lifting power would be eight feet diameter. I consider that the emergency balloon might be even of 10 feet diameter without its transport being impracticable in places inaccessible to waggons.

It has often been urged that a signalling balloon is only of use in calm weather. The view on the screen which I am able to show you by permission of the "Daily Graphic," contradicts such a statement. It illustrates the use of electric signalling balloons in half a gale of wind on the evening I carried out

experiments at the Stamford Bridge Grounds in the presence of H.S.H. Prince Edward of Saxe-Weimar and a number of Military and Naval Experts of various nationalities. I accomplished the ascent by using a number of guy ropes. There are also possibilities in the combination of a kite with a balloon in windy weather. On the screen is the large kite which Mr. Douglas Archibald made for me some years ago. I have not, however, as yet, in my experiments adopted such a combination, as I have found guy ropes exceedingly efficient.

The next view shows the use of the electric balloon from board a ship, for such a method of signalling would be incalculable to the Navy. It would ensure signalling from below the horizon and round corners in coast defence. The last view shows the use of the balloon as a point light in Arctic exploration—a form of war indeed, but one that is in perfect harmony with civilisation—the international struggle against the forces of nature which are in opposition to the attainment of knowledge and the discovery of truth.

The CHAIRMAN: I think we shall agree that we shall have to thank Mr. Bruce for his very interesting paper. And now we are to have "The Weczera Flying Machine," by Mr. L. W. Broadwell, with exhibition of the model of the machine which has lately arrived from Hungary. We regret to find that Mr. Broadwell is ill and not able to read his paper; Mr. Bruce will therefore be kind enough to read it for him.

ANTON WECZERA'S FLYING MACHINE.

By L. W. BROADWELL.

Mr. Chairman and Gentlemen of the Aeronautical Society:—The flying machine a working model of which I have now the honour to submit to your critical inspection—is the invention of M. Anton Weczera, a Hungarian architect, who has devoted many years to the study of a question which has such a special interest for your Honourable Society.

I, too, have devoted considerable attention to this subject; but whilst studying the construction of the many flying machines that dispense with the use of an air-bag, I have invariably failed to find in any of them an adequate and reliable lifting capacity, which, in my opinion, is the most essential element in all of them, and without which there can be no practical success.

Given, however, a method of construction which enables a machine to lift itself, together with its requisite cargo, and also to maintain itself at any desired level in the air, then there will be no difficulty in devising the necessary driving and guiding apparatus for it. Hence an effective combination of these three essential elements—viz. the lifting, driving and guiding—would certainly constitute a successful flying machine.

Now let us examine this model with a view to forming an accurate opinion of the most important among these three elements—viz. its *lifting* capacity—and if it be found to give a reasonable promise of success, then we may fairly claim to have gone far towards solving the momentous question of aerial navigation.

Many inventors have carefully studied the mechanical construction of birds' wings in the hope of utilizing the knowledge thus obtained in lifting and driving flying machines—but thus far in vain. The present model is also an effort in the same direction. There is no great difficulty in mechanically imitating the construction of a bird's wing, but no one has yet been able to manipulate and utilize such a combination as the birds do. The inventor of this model, however, claims to have done both, in a measure at least.

You will observe that the inclined planes or screw-blades in all the wheels of this machine have a downward fold at the outer edge or periphery thereof, in imitation of a similar feature existing in the formation of a bird's wing, and designed in both cases to *grasp*, as it were, the atmosphere in their downward and rearward sweep, which act lifts and propels both bird and machine—more or less in the case of the latter, according to the degree of inclination given to these artificial wings and the rapidity with which they are revolved.

These wheels are driven in opposite directions, that is, *inwards* towards each other, and are, thereby, made to co-operate in the tasks of lifting and propelling. When driven at a speed of 1,500 or more revolutions per minute they will probably accomplish all that is desired. This speed and more should be easily attained by the employment of a suitable motor, such, for instance, as that of Hon. Charles Parsons in his "Turbinia," which drives its nine double-bladed screw-propellers at a speed of 2,100 turns per minute, *under water*.

The large wheels are chiefly designed to lift the machine, and also to maintain it at any desired altitude by regulating the number of their revolutions. They can, moreover, be utilized to some extent in *propelling* the machine, though most of that work has to be done by the smaller wheels. These latter are

so mounted that they may be raised or lowered through the arc of a circle whilst in action—thereby becoming partly driving and partly guiding devices, and thus completing the machine in principle.

Doubtless, when constructing a large machine, many modifications of detail may be found necessary, as indeed in perfecting most inventions.

The inventor suggests that the coupling together of two such machines as the present model would be found advantageous.

The CHAIRMAN: As Mr. Broadwell was not able to be present this evening, he has deputed his son to explain it; but he has had very short notice and we have to thank him very much for what he has shown us. Our next business is "Foreign Communication—Dr. R. Danilewsky's Flying Machine" illustrated by photographs supplied by the inventor. This paper has been sent, and Mr. Bruce will be kind enough to read it for us.

DR. DANILEWSKY'S DIRIGIBLE FLYING MACHINE.

I have lately received several communications from Dr. Danilewsky concerning his combined balloon and aeroplane. The latter of these are in the form of pamphlets in Russian and in German, and as these are too lengthy to read in full, I have by me a few short remarks to give some idea of the matter of these pamphlets, and to explain the photographs. Dr. Danilewsky calls his apparatus a "Dirigeable Flying Machine"; and on the occasion of his experiments for the Russian Government, the authorities present expressed surprise at the ease with which the machine was guided. From a study of the plans of the mechanism, it seems to me that Dr. Danilewsky has certainly attained to a simple means of controlling at will the movement of the machine, not only horizontally, but vertically, as long as the wind is light. I believe he does not as yet claim to guide the flying machine against a strong wind.

Dr. Danilewsky states in his pamphlet that he is not as yet satisfied with the simplicity of his guiding arrangements. He thinks simplicity so essential to safety that he wishes to eliminate both chains and wheels.

The apparatus consists of an elongated balloon placed vertically, an aeroplane, and steering apparatus, with seat for the aeronaut. I now show you a photograph of the machine in mid-air, which was sent me by Dr. Danilewsky. The vital principle of the whole machine and the reason for the existence of the balloon is the neutralisation of the weight of the man, the aeroplane, and the steering mechanism. But there must be no excess of lifting power. There were two accidents, in October '97 and October '99 respectively, which Dr. Danilewsky attributes to incorrect equilibrium and to the machine being lighter than the air. The aeroplane is a four-cornered bamboo framework on which are cross wings or shutters; these can be moved by simple apparatus to the desired angle and automatically fixed. These shutters are also a framework covered loosely with silk. The steering apparatus worked like a velocipede by the feet of the aeronaut by means of a chain and gearing arrangement, which carries the motion on to a form of screw; at both ends of this are cross pieces on which are four flat plates, two at each end. Each of these plates is a hexagonal framework covered loosely with silk. They are made to revolve and beat the air, striking it first flatly, and then in the upper portion of their revolution they cut the air as they strike across it. There are means on either side of the aeronaut by which he can direct the moving-power upwards, downwards, forwards, or backwards. The number of single impulses on the air of these hexagonal surfaces in quick work is about 16 per second.

DISCUSSION.

The CHAIRMAN: Does anyone wish to make any remarks upon these papers?

COLONEL ALLAN CUNNINGHAM: I should like to say that I have been present at a trial of a military balloon with a kite attached, Mr. Archibald's own. He was present and put the kite on with his own hands. The circumstances were rather unfavourable to him. I am bound to say the fact is that there are so many strings to the kite that it is rather a difficult thing to attach the kite to the balloon at all. Then, when attached, there is still a good many practical difficulties in the way of handling the balloon, so that the two things together do not form a handy combination. The idea of the mixture is very good theoretically; that is to say, the balloon is a very inconvenient thing to handle in a high wind, whereas the kite acts best in a high wind, so that it seems the combination might do very well in a high wind. But they are very difficult to work together. On that occasion the combination of the balloon and kite was not successful; it was not at all a convenient combination. It was a great many years ago I saw it, and I have not heard of any great success since. Then there are two questions I want to ask for information. One is about the "Emergency Balloons"—Mr.

Bruce's own—I did not catch what the size of the smallest "Emergency Balloon" suitable for work would be. Then as to the little difficulty that the particular balloons tried to-night had in rising, I would just like to remark that the barometer is very high to-night and the pressure of the air must be very considerable. It would seem that there must be something heavy in the gas. The ordinary gas of the quality used for balloon ascents ought to be more efficient than usual with such a heavy barometer as we have now.

Mr. Bruce: As far as the question of the kites is concerned, it has not been my idea to combine the two. I find guy ropes most effective. I mentioned the possibility because I think it is fair to mention everything that might be utilized. The combination has not been my method of raising balloons in windy weather, although, of course, I perfectly admit the tremendous value of kites by themselves for various purposes. I shall show some photographs presently depicting Major Baden-Powell's use of kites for wireless telegraphy at the front, where they have been of tremendous value. I am glad to see Mr. Douglas Archibald here, who made the large kite for me. He was the first to make a kite for meteorological experiments. I have just had sent to me by Mr. Rotch from Blue Hill Observatory particulars of his latest triumphs in the way of kites, but I have not had time to read them yet; at the same time, I believe he has succeeded tremendously, and I hope to put the paper in the next number of the Aeronautical Journal. I have also just received the report of the "Weather Bureau Kite Observations" of 1898 from the United States, and it will be seen they have aided meteorology immensely.

The Chairman: Would Prof. Langley favour us with any remarks?

Professor Langley: I am extremely obliged, Mr. Chairman, for the reference made to me; but really, I have nothing that can add to the interest of the very interesting communications that we have heard to-night.

Mr. Douglas Archibald: May I say a word? Colonel Cunningham referred to the kite and balloon together. I might explain that the combination was originally thought out, but what he saw was a very rough preliminary notion of how to mix the two together. If the details were worked out, and the whole thing worked in a more workmanlike way than it was on that occasion, I do not see any reason why the difficulties that he mentions might not be got over. At the same time I confess that I have never had the time or the inclination to carry out the kite balloon any further than just to put the idea forward, and since then kites have themselves done such splendid work. For meteorological purposes, they appear to me to be the very best means we have of exploring the upper regions, better even than balloons, that I am quite content to let the kite-balloon go by. I may say, in reference to what Mr. Bruce mentioned just now about Mr. Rotch's experiment in America, that I think it is only fair to say that he began after he saw mine in England. I think he has achieved, through the help of Mr. Clayton, some of the best investigations that have yet been made of the upper regions. Lately, they have reached the height of 14,000 feet with instruments, and that is as high as one would care to fly a kite—an enormous height—and they have been able to take observations of the heavens at that height, and they have made some very interesting discoveries of the nature of the currents of the atmosphere, which will also help balloonists and flying machinists, and, I think, both those sciences will help each other. I should like to ask Mr. Bacon if he has ever noticed in the cloudy strata that he has got greater velocity than either before or after, because the observations of Bluehill seem to show that it occured either above or below the cloudy stratum. Perhaps he has not taken observations from that point. But it shows that we are learning by means of kite observations things that would be impossible by other means. And a great deal of this work of the last paper that has come over from Mr. Rotch, I think, is as important a contribution to the science of metereology as anything I have seen for the last 20 years.

Member (name missed): I should like to know with regard to the Danilewsky Flying Machine whether there was any data as to the velocity with which it could be guided by means of the interesting apparatus we saw on the screen. The mechanical part of it is apparently so out of proportion to the mass which has to be propelled through the air that it does not seem that any very high velocity could be attained. Then, with regard to the use of aluminium in signalling balloons. I think it is now a matter that has been almost solved by engineers that steel is a stronger metal strength for strength and weight for weight, so that there is really no object in using aluminium. I think that is Mr. Maxim's experience. I should like to know why aluminium is still used.

Mr. Bruce: You could not get the balloon up with steel. We do not want great strength, we want lightness. Aluminium is the lightest.

Member: That is the point raised. I say steel is lighter than aluminium strength for strength.

MR. BRUCE: But if you make that ladder of steel, you cannot have it very much finer than the one we have here.

Another Speaker: I imagine it is rigidity you want. If you made it of steel you would not have the same rigidity; steel wire might be lighter and stronger than your aluminium, but you would not get the same rigidity.

MR. BRUCE: Yes, that is so.

MR. BRUCE: I am very anxious to show the meeting the photographs of Major Baden-Powell's experiments at the front with his kites. I am indebted to Miss Baden-Powell for sending me these pictures, and I am able to show them to you by the kindness of the editor of "The King" who has lent them to the Aeronautical Society for the use of this evening.

MR. BRUCE then exhibited a number of pictures illustrating Major Baden-Powell's experiments at the front.

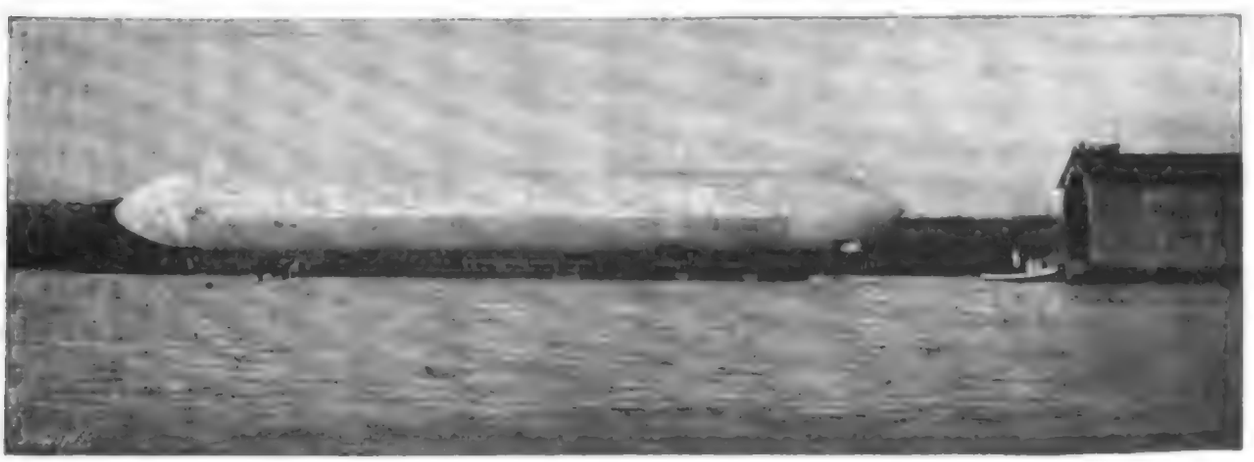
MR. BRUCE: Before we separate, there is one point I wish to speak about, and that is about the Paris International Congress. When I was over in Paris, I was most hospitably received by the French Aeronautical Society, and I am very glad we are going to be represented at the Congress. Some of our members are down on the list, but there ought to be more, because it is one of the most important Congresses ever held. I am sure we are all agreed that it is most important in the progress of aeronautics to have international consultation and international agreement on scientific subjects.

The CHAIRMAN: Ladies and Gentlemen,—After the very interesting papers and illustrations we have seen this evening, we have to thank those gentlemen who have interested us so much. I do not propose to detain you any length of time, but I may mention one thing, and that is that in France they are working very hard at this problem, and we are informed that the Aero Club in France has offered a prize of 100,000 francs to the aeronaut who, either in a balloon or a flying machine, starts from the ground and makes a journey round the Eiffel Tower and returns within an hour. It is a distance of about six miles. I shall not detain you with any further remarks, but thank you for your attendance here this evening.

A vote of thanks to the Chairman, proposed by Mr. Hiram Maxim, terminated the proceedings.

Aeronautics in 1900.

The present year has been remarkable for aeronautical enterprise and experiment. The greatest achievement, no doubt, has been the trial trip of the Zeppelin Airship, which has been fully chronicled over and over again in the daily papers, and the periodicals. As has often been the case in aerial experiments, the results of the trial trip were, at first, exaggerated, and the news that first came to hand stated that the Zeppelin Airship had journeyed 35 miles against the wind. No wonder was it therefore that some daily papers announced that the solution of the problem of aerial navigation had been accomplished by the venerable German Count. But the illusion was dispelled in this country at the meeting of the Aeronautical Society on July 17th, when Mr. P. T. Alexander, who was replying to Mr. Maxim's paper on the Zeppelin Airship, stated that the distance was really only 3.5 miles, the decimal point having escaped



From Pearson's Magazine] *[by kind permission of the Editor.*

THE AIRSHIP AT REST JUST OUTSIDE ITS SHED.

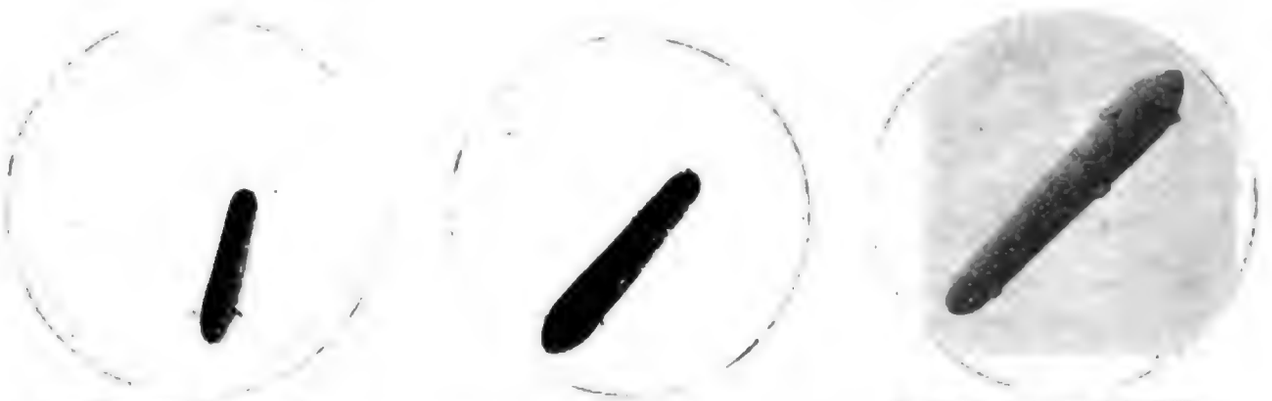
Digitized by Google

the notice of the telegraphists. Disappointment at hearing the truth, has caused some writers to go to another extreme, and disparage the experiment as a failure. A wiser course is the avoidance of either extreme of criticism. The first journey of the Zeppelin Airship cannot be said to have solved the problem of steering a balloon against a considerable wind, but it has, all the same, been a well-designed and ably-executed experiment, and even if the particular form of the airship is not destined to survive, still, valuable experience must have resulted from many of the details of the novel structure, details which have already been so carefully described in this journal by Major Baden-Powell.* To take but one example, it appears that the fabric of which the balloons of airships are made, are exceptionally gastight. The Zeppelin experiment was worth all the money bestowed on it, if a really gastight material has been its only outcome.

The Aeronautical Journal has received many photographs and illustrations of the Zeppelin Airship. These illustrations are published in the current number, which are considered to be the best. These appeared in the September number of "Pearson's Magazine," and they are now reproduced by kind permission of the editor.

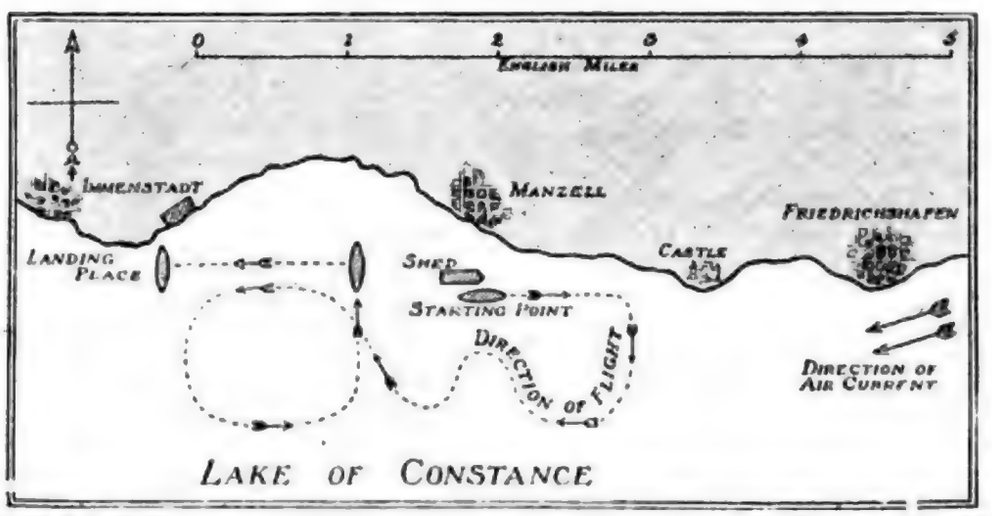
Next to the Zeppelin Airship, M. Santos Dumont's motor balloon is, perhaps, attracting most of the attention of experts. A mention of this machine will be found in the Notes of the current issue. Further details of his latest balloon are held over until the next issue of this journal.

Apart from the attempts being made to render balloons independent of wind direction, much excellent work has been carried out during the year with the ordinary balloon in its primitive unsteerable condition, and the long voyages that have lately been carried out on the Continent certainly testify to an increase of skill on the part of modern aeronauts.



From Pearson's Magazine] *[by kind permission of the Editor.*

THREE SNAPSHOTS OF THE AIRSHIP DURING ITS FIRST VOYAGE.



From Pearson's Magazine] *[by kind permission of the Editor.*

MAP OF THE COURSE OF THE AIRSHIP.

* The Zeppelin Airship, AERONAUTICAL JOURNAL, Oct., 1899.

Digitized by Google

The example of recent skill in balloon manipulation is given in another column of the Journal, where M. Jacques Faure's successful balloon voyage across the Channel in September last is chronicled. This latter journey is especially worthy of note, as it was a pleasant instance of International work and co-operation in the carrying out of aerial experiments. During this year in this country, the Rev. J. M. Bacon has greatly extended his past experiences as a scientific balloonist. One of his ascents took place in a thunderstorm, and this fact has been the cause of much interesting correspondence in scientific and other journals, as to the possibilities of balloons being struck by lightning. Besides the experiments in the open, with flying machines and balloons, the less sensational experiments having a bearing on important aeronautical matters, and which have been carried on in the laboratory, demand the earnest attention of students. In another part of the journal will be found an account of the experiments of Messrs. W. G. Walker and P. T. Alexander, on "The Lifting Power of Air Propellors," a perusal of which will render evident the fact that in 1900 the science of aeronautics is not the pursuit of the fanciful or of the dreamer, but of the stern and matter-of-fact experimentalist.

M. Jacques Faure's Balloon Voyage across the Channel.

On September 1st, M. Jacques Faure, the treasurer of the Paris Aero Club, accompanied by Count Kargarion, ascended from the grounds of the Crystal Palace in his balloon "L'Orient," for the purpose of crossing the Channel. The local arrangements for the ascent were made by the Aeronautical Society of Great Britain at the request of "La Societe Francaise de Navigation Aerienne," Mr. Henry Gillman, the present excellent and most energetic manager of the Crystal Palace having generously placed the historic balloon ground of that establishment at the disposal of the French aeronauts. There is no place in the United Kingdom where a balloon can be so promptly inflated as at the Crystal Palace, and the operations of its highly-trained staff received the highest commendation from M. Faure. M. Mallet, the Parisian aeronaut, who had journeyed from Paris in charge of the balloon, superintended all the arrangements preparatory to the ascent. On the morning of September 3rd, a telegram was received by Mr. Eric Stuart Bruce, the Honorary Secretary of the Aeronautical Society of Great Britain, from M. Faure to the effect that the aeronauts had safely crossed the Channel and descended at Alettes, near Boulogne. A telegram from the Aeronautical Society of Great Britain was immediately despatched to M. Faure, congratulating him on his successful voyage.

Mr. Eric Stuart Bruce since received the following kind letter from M. Faure, descriptive of his voyage, and showing his appreciation of the aid he received from the British Aeronautical Society. This is translated from the French by Helen Auxilium Bruce.

10, Rue La Fayette, Paris,
Sept. 3rd.

Dear Sir,—I confirm in this my telegram of yesterday in which I informed you that I had fortunately landed at Alettes, a little village in the department of Pas de Calais between Etaples and Montreuil-sur-Mer. I must first thank you for all your kind help in facilitating my departure from London, and I feel that it is to you that I owe much of the success of my enterprise.

Leaving the Crystal Palace at 7.30, I easily found my level at about 100 metres up, so that I was able to communicate with the earth several times, and so ascertained my whereabouts. Thus, I found I passed exactly over the tower of St. Mary Crey, and travelled right down the county of Kent, recognising on my left the Thames lighthouses, so that I think I struck the sea between Deal and Sandwich at about 11 p.m. The wind was favourable, so I did not hesitate to attempt the crossing of the straits and taking the precaution of mounting to about 700 metres, and maintaining that altitude so that I might be able to note my direction by the stars, it appeared to me that I went continuously south-east. At 2.30 I saw, on the left, a lighthouse that I knew later on to be that of Boulogne. I followed the French coast from Boulogne to the mouth of the Cancho, hearing on my left the sounds of earth, the railway trains, and the barking of dogs, etc., and on my right the rise and fall of the sea.

I effected a landing under good conditions at 3.20 in the morning near the little village of Alettes. As you see, my journey was accomplished under the best conditions and with no incidental accident. I hope, Monsieur, to have the pleasure of seeing you when you come to Paris for the Aeronautical Congress, so that I may thank you personally for all you did for me. Yours, &c.,

JACQUES FAURE.

The Recent High Kite Ascents at the Blue Hill Observatory.

Mr. Lawrence Rotch, of the Blue Hill Observatory, has communicated the results obtained in two very high Hargrave Kite flights, which have beaten the record of the ascents at the Meteorological Observatory. On June 19th, the altitude of 14,000 feet was reached. This exceeded the greatest height previously obtained at this observatory by 1,440 feet. At this height the temperature was 15 degrees below the freezing point, the wind velocity was 25 miles an hour from the North-East, and the air was very dry. The kites remained near the highest point from 5 to 8 p.m., when they were reeled in rapidly by a small engine. In the descent the kites passed through a stratum of thin ragged clouds at a height of half a mile. These were moving with a velocity of some 30 miles an hour. At this time the wind at the observatory, situated about 600 feet above the general level of the surrounding country, had fallen to a calm.

But even this record is broken in the second ascent described by Mr. Rotch. On July 19th, the kites attained a height of 15,900 feet above the sea level. The recording instruments attached to the kites showed freezing temperature at the highest point, and a North-East wind with a velocity of 26 miles an hour. The air was again found to be very dry.

The Paris International Aeronautical Congress.

This important event took place from September 15th—20th at Meudon. Amongst the members of the Aeronautical Society who contributed papers were M. Eric Stuart Bruce, who contributed a paper on "Electric Balloon Signalling in Arctic and Antarctic Exploration," and Mr. P. Y. Alexander. This latter gentleman forms one of the voyagers in Dr. Berson's great balloon ascending from Berlin. Just on going to press a telegram has been received from him from Friedenau dated September 24th: "Leaving to-night 5.53, direction East."

The details of the work of the Paris Congress must, from want of space, be held over until the January issue.

Lifting Power of Air Propellers, being Experiments with Propellers 30 ft. in Diameter.

By William George Walker, A.M.I.C.E., M.I.M.E.

These experiments were carried out during the latter part of 1899, with the expert and financial assistance of Mr. Patrick Y. Alexander, of Experimental Works, Bath.

Experimental Apparatus. Five propellers 30 feet in diameter were tried, lettered A., B., C., D., E., the skeleton structure of the blades was also tested, the different propellers were formed by altering the canvas stretched on the skeleton blades. The skeleton propeller was made as light as possible, and for reasons of strength and lightness, a Mangin type of propeller was used of four blades, the blades being fixed one behind the other, and connected together by diagonal struts and ties; the blades were 3 feet 1½ inches apart. A pair of blades are thus, from a structural point of view, similar to a "warren" or lattice girder supported at one end, the respective blades of one pair constituting the upper and lower flanges of the girder; therefore, when the propeller is exerting a thrust, the members of one blade will be in compression, and the other in tension. The blade-frames are made of solid drawn steel tubes of best quality and of different diameters and gauges, the tubes are joined together by brazed sockets. The width of the blade frame was 6 feet with a length of 15 feet.

The propeller was mounted on a horizontal shaft 4 ins. in diameter, and driven by a portable engine by means of a six-inch belt. The diameter of the engine cylinder was 8¾ inches with a stroke of 12 inches. The boiler pressure varied between 60 and 75 pounds per square inch. The driven pulley on the propeller shaft was 5 feet in diameter. Several pulleys of different diameters were employed on the engine, varying from 2 feet to 3 feet in diameter. With smaller diameter pulleys the belt was found to slip somewhat at the high speeds. Practically no slip occurred during the present readings with the larger diameter pulleys.

The propeller shaft was free to move in its bearings longitudinally, a powerful ante-friction swivel was attached to the end of the shaft on the discharge side of the propeller, to

Digitized by Google

which was attached a Salters balance capable of reading up to a pull of 1,000 pounds, and reading to a pound a movement of 1½ inches of the shaft was sufficient to move the needle right round from zero to 1,000. The balance was tested by means of weights before and after the experiments. The propeller shaft ran very freely in its bearings, requiring only a few lbs. thrust to move it horizontally when revolving.

Propellers. The five propellers tried which are lettered A. to E., all 30 feet in diameter. Propellers A. to D. had their blade surface set at an angle of 12½ degrees to the plane of rotation. Propeller E. was set at an angle of 21 degrees.

A. had four blades each 6 feet wide, giving an area of 350 square feet.

B. had two blades each 6 feet wide, giving an area of 175 square feet.

C. had four blades 3 feet wide each, giving an area of 175 square feet formed by stretching the canvas on half the longitudinal length of the blade structure.

D. had four blades 3 feet wide each, giving an area of 103 square feet similar to C., but with 6 feet radius of blade surface removed from each blade, leaving four tips 9 feet long by 3 feet wide.

E. had four blades exactly the same as A., only set at an angle of 21 degrees to the plane of rotation.

Experimental Building. The room was 210 feet long, 68 feet wide, and 60 feet high. The axis of the propeller was nearly central with that of the room and 17 feet above the floor surface, the centre of the propeller being about 30 feet from one end of the room, arranged so to feed from the wall's side. The air space was ample for the proper circulation of the air. The disc area of the propellers was 707 square feet, while the sectional area of the room in same plane as propeller was 3,600, leaving an area of 2,893 square feet for the flow of air back into the propeller. The air was discharged in the form of a cylindrical column about 30 feet in diameter down the long room, returning by the walls and passing the propeller through the disc area of 2,893 square feet and again into the propeller.

Mode of Experiment. Each propeller was tested at about 10 different speeds (including the skeleton blades) varying from 20 to 60 revolutions per minute. The thrust in pounds, revolutions of propeller and engine, together with an indicator diagram, and steam pressure were taken simultaneously for each different speed. These experimental readings are given in tables 1 to 8. A Crosby Steam Indicator was used, which was compared with a Richards Indicator, and found to agree. Tables 1 to 6 give results for propeller speeds of 20, 25, 30, 35, 40, 45, 50, 55, and 60 revolutions per minute.

The friction of the unloaded engine was also obtained, which includes the friction of the belt and propeller shaft, obtained by removing the propeller and running the engine light at progressive speeds. The mechanical efficiency of the engine, belting, and shafting was obtained for different loads by means of a brake dynamometer applied to the propeller shaft; this efficiency multiplied by the I.H.P. gives us the B.H.P. for that particular H.P. Every care was taken so that the results should be as accurate as possible, and the readings were taken by a staff of four observers.

Tabulating Results. Referring to tables 1 to 5. The tip speed corresponding to the revolutions is given. The total I.H.P., the brake and power to overcome the friction of the unloaded engine has been given. The power necessary to overcome friction due to working load may be obtained by adding friction and subtracting the results from the I.H.P. The thrust in lbs. per I.H.P. and B.H.P. are inserted.

Examination of Results. Taking the experiments as a whole, and making allowances for experimental errors, the following relations are verified.

(1). The thrust varies as the square of the revolutions.

(2). The H.P. varies as the cube of the revolutions.

(3). The thrust per H.P. varies inversely as the revolutions.

For a given I.H.P., E. gave the greatest thrust, at 16 I.H.P. the thrust was 260 lbs., A and C 212 lbs., D. 192 lbs., B. 132 lbs. respectively. At the same number of revolutions A. gave about double the thrust of B.

For equal tip speeds the thrust per H.P. for propellers C. and E. were nearly equal. Propeller B. of two blades was the least efficient of the series.

The thrust per I.H.P. of B. and E. at 50 revolutions per minute was 9.4 and 15 respectively. E. required 18.7 I.H.P. to drive it at 50 revolutions, while the I.H.P., absorbed by the skeleton propeller, was 7.8, and that of the unloaded engine 2.05 I.H.P.

Measurements of Air Discharged. The velocity of the air at different points entering as well as on leaving the propellers B. and E. was measured. Anemometer readings were taken at a distance of 2 feet in front of the propellers, as well as behind, and at intervals

of 2 feet. No delivering tube was employed, the propeller being entirely open in front as well as behind. The air on the delivery side at the distance of 24 inches, at which the readings were taken, had no tendency to spread beyond a radius slightly greater than the extreme radius of the blades. The velocity of air at different points on the delivery side is given in tables 7 and 8. From all points behind the propeller, the air is sucked into the rarefied spaces left by the revolving blades and discharged in an axial direction in the shape of a cylindrical column of air having a spiral motion, the pitch of the spiral depending upon the angle at which the blades are set.

The cross section of the propeller disc on the delivery side was divided into eight imaginary concentric rings, and anemometer readings were taken at the following radii, which correspond to the centre line of the rings, viz., 2, 4, 6, 8, 10, 12, 14, and 16 feet. The velocity of air in feet per minute as ascertained at each of the 8 radii, was multiplied by the area of the corresponding rings in square feet; and the product being added together, gave the number of cubic feet of air discharged per minute. Propeller B. discharged 233,230 cubic feet of air per minute at 35 revolutions, and 3.8 I.H.P. giving a thrust of 42 pounds. Propeller E. discharged 363,140 cubic feet at 32½ revolutions per minute, requiring .58 I.H.P., and giving a thrust of 120 pounds.

The thrust may be approximately calculated at different radii from the amount of air discharged at the respective points.

It will be noticed that the thrust per unit area is a maximum near the tips, and rapidly falls off near the central parts.

Weight and Strength of Propellers. The weight of the propellers was about 120 lbs. each, not including the canvas. The propeller was designed strong enough for a thrust of 600 lbs. at a factor safety of 3½. Taking the steel tubes at 30 tons per square inch, a formula was employed suitable for long columns and pin joints, whereas the tubes might be taken as short columns and stiffened joints, this would give a much higher strength. The author has no reliable data on the compressive strength of short tubes, and, therefore, made use of results more suitable for long ones.

The strength of the blades were tested statically by loading the extreme tips with weights. The deflection curves are shown in Fig. 14 for axial strength or thrust and twisting strength. The plotting shows the limit of elasticity was not reached. This was experimentally verified, for all loades up to breaking, which was due to one of the brazed sockets giving out, with 600 lbs. suspended from the tip of a blade in an axial direction. The twisting strength of the blade was not tested to breaking point. It is clear that by making the sockets of malleable iron instead of gun metal, the weight could have been materially reduced.

Discussion on Results. Comparing A. and B., it will be noticed that the proximity of the wide blades arranged, "Mangin" type did not reduce the thrusting power of the propellers, for at the same number of revolutions A. gave practically double the thrust of B. C. had four narrow blades of a total area of 175 square feet, while A. had the same number of blades but of double the width and an area of 350 square feet, yet their efficiencies were about equal. This seems to show that within certain limits narrow blades are quite as efficient as wider ones, giving the same total thrust at equal tip speeds. D. had 6 feet length of each blade removed from the central parts, otherwise, the propeller was similar to C. At 50 revolutions per minute the thrust of C. and D. was 159 to 148 respectively. With 16 I.H.P. the thrust of D. was 20 less than C., showing that the area of the central parts of the propeller is not very effective. The skeleton blade absorbed a considerable amount of power. At 50 revolutions, the power necessary to drive the skeleton was 60 per cent. of the power necessary to drive A. at the same speed. So that the application of 350 square feet of canvas only required only 5 extra H.P., and to give a thrust of 196 pounds.

Design of Propellers. In the design of suitable lifting propellers for aeronautical purposes, there are many practical and theoretical points to be considered. For instance, it would not be economical to arrange for too high a thrust per H.P. due to consideration of the weight of propellers. Taking into account the weight of the propeller, there is a particular thrust per H.P. which will give the highest efficiency. The experiments give data sufficient for the design of any other size of propeller, and even of distinctly different design within certain limits. It is clear that the thrust and H.P. can be approximately arrived at for any particular speed. For instance, to drive propeller E. at 100 revolutions per minute, it would require about 100 B.H.P., and give a thrust of 1,125 pounds. It is not the author's intention in this report to go into the design of a propeller, although, perhaps, a few brief particulars of the line of action may be interesting.

Referring to propeller E. at 45 revolutions per minute, it gave a thrust of 240 lbs. with 14 I.H.P., or at 17.1 lbs. per I.H.P. Now this figure can be considerably improved—

(1). By reducing the skin friction of the surface.

(2). By reducing the resistance of the blade structure.

By making the blades half the width, which can be done without reducing the efficiency, the first loss may be approximately halved. This will also concurrently reduce the loss in the second quantity. The experiments showed that the resistance of the structure was excessive, which can be reduced by eliminating some of the diagonals and other struts near the tips. The presence of struts in the central parts absorbs comparatively little power, and their number if necessary may be augmented. As far as possible the blades at the tips should only be strengthened by wire.

For the sake of example, suppose this loss is reduced 2 I.H.P. in the case of propeller E. at 45 revolutions per minute, bringing it to 12 I.H.P. Again, in this particular case, loss in friction, due to belt and engine, was 30 per cent., so that we may approximately say that with this particular type of propeller 11 I.H.P. will give a thrust of 240 lbs., or a thrust of about 21 lbs. per I.H.P. This will be equivalent to a thrust of 25 lbs. per B.H.P. Now, assuming that no loss occurs due to interference of the air when multiple blades are introduced, the thrust and H.P. will vary directly with the number of blades at same revolutions. Suppose, therefore, we arrange for 12 blades, this will give a thrust of 720 lbs., and require 33 I.H.P.; with 18 blades, the thrust would be 1,080 lbs., and the I.H.P. 49.5. Increasing the revolutions to 60 would give us a thrust in the latter case of 1,836 lbs., and would require 125 I.H.P.

Of course, by going in for a lower tip speed, the thrust per H.P. is proportionately greater.

Applying the 18 blades to a propeller of 50 feet in diameter, we have, running at 30 revolutions per minute, thrust 3,700 lbs., I.H.P. 190. At 20 revolutions per minute we have, thrust 1,640 lbs., I. H. P. 57.

The above calculations are made on the assumption that the surface and projections are nearly as rough as the experimental propellers. It seems clear that taking into consideration the resistance and lifting power of a smooth inclined surface, the allowances for friction losses is high, and that the power given, can, with ordinary care, be much reduced.

In considering whether the proximity of the blades will interfere with each other, it must be borne in mind—

(1). The diameter is large.

(2). The speed is small, the tips revolving at a large radius, approximating ordinary aeroplanes moving in a straight line.

The following nine papers by the author may be useful as reference: "Experiments on Screw-Propeller Surface," Inst. M.E., 1892; "Experiments on Ventilating Fans," British Association 1893; "Experiments on Propeller Ventilating Fans," Inst. M.E., 1897; "Supplementary Experiment Propeller Fans," Inst. M.E., 1897; "Speed Trials," British Association 1897; and "Lifting Power of Air Propellers," British Association 1899.

TABLE I.

PROPELLER A. DATE OF EXPERIMENT: OCTOBER 9TH, 1899.

4 WIDE BLADES. AREA, 350 SQUARE FEET. ANGLE OF BLADES, 12½ DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,230	4,700	5,170	5,640
Thrust in Pounds	32	45	62	84	109	143	188	245	288
I.H.P.	1·1	2·1	3·4	5·1	7·2	9·7	12·8	16·6	20·8
B.H.P.	·4	1·1	2·1	3·4	4·9	6·8	8·9	11·6	14·6
Thrust per I.H.P.	29·1	21·4	18·2	16·5	15·2	14·7	14·5	14·7	13·8
Thrust per B.H.P.	74·7	40·3	29·6	24·8	22·0	21·0	20·7	21·0	19·7
H.P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	1·8	2·1	2·3	2·6

Digitized by Google

TABLE II.

PROPELLER B. DATE OF EXPERIMENT: OCTOBER 10TH, 1899.

2 WIDE BLADES. AREA, 175 SQUARE FEET. ANGLE OF BLADES, 12½ DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,230	4,700	5,170	5,640
Thrust in Pounds	18	25	33	42	54	69	89	116	154
I.H.P.	1·1	1·7	2·7	3·8	5·3	7·2	9·5	13·0	17·6
B.H.P.	·4	·8	1·6	2·4	3·5	4·3	6·6	9·1	12·2
Thrust per I.H.P.	16·4	14·7	12·2	11·1	10·2	9·6	9·4	8·9	8·8
Thrust per B.H.P.	42·0	30·0	21·0	17·6	15·2	13·9	13·4	12·7	12·6
H.P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	1·8	2·1	2·3	2·6

TABLE III.

PROPELLER C. DATE OF EXPERIMENT: OCTOBER 12TH, 1899.

4 NARROW BLADES. AREA, 175 SQUARE FEET. ANGLE OF BLADES, 12½ DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,230	4,700	5,170	5,640
Thrust in Pounds	30	43	58	77	101	127	159	198	244
I.H.P.	1·1	1·8	2·7	3·8	5·4	7·4	10·3	14·2	18·5
B.H.P.	·4	·9	1·6	2·4	3·6	5·2	7·2	10·0	12·9
Thrust per I.H.P.	27·3	23·9	21·5	20·5	18·5	17·1	15·4	13·9	13·2
Thrust per B.H.P.	70·0	47·8	37·0	32·2	27·5	24·6	22·0	19·8	18·8
H.P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	1·8	2·1	2·3	2·6

TABLE IV.

PROPELLER D. DATE OF EXPERIMENT: OCTOBER 13TH, 1899.

4 NARROW BLADES. AREA, 103 SQUARE FEET. BLADE-SURFACE REMOVED TO A RADIUS OF 6 FEET. ANGLE OF BLADES, 12½ DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,230	4,700	5,170	5,640
Thrust in Pounds	23	35	50	69	92	118	148	186	224
I.H.P.	1·0	1·8	2·8	4·2	5·9	8·2	11·2	15·0	19·8
B.H.P.	·4	·9	1·6	2·7	4·0	5·7	7·8	10·5	13·9
Thrust per I.H.P.	23	19·4	17·9	16·4	15·6	14·4	13·3	12·4	11·3
Thrust per B.H.P.	62·8	38·8	30·6	25·4	22·9	20·6	19·0	17·7	16·1
H.P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	1·8	2·1	2·3	2·6

Digitized by Google

TABLE V.

PROPELLER E. DATE OF EXPERIMENT: OCTOBER 20TH, 1899.

4 WIDE BLADES. AREA, 350 SQUARE FEET. ANGLE OF BLADES, 21 DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	45	50	55	60
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,230	4,700	5,170	5,640
Thrust in Pounds	55	77	104	136	179	240	280	340	405
I.H.P.	1·1	2·6	4·2	6·3	9·6	14·0	18·7	23·3	32·0
B.H.P.	·4	1·5	2·7	4·3	6·7	9·8	13·5	16·3	23·0
Thrust per B.H.P.	150	52	38·7	31·7	26·6	24·4	21·4	20·9	18·0
Thrust per I.H.P.	52·4	29·6	24·9	21·6	18·6	17·1	15·0	14·6	12·6
H.P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	1·8	2·1	2·3	2·6

TABLE VI.

SKELETON BLADES. DATE OF EXPERIMENT: OCTOBER 16TH, 1899.

ANGLE OF BLADES, 12½ DEGREES.

Revolutions of Propeller per minute	20	25	30	35	40	50	60	70	80
Tip Speed in feet per minute ..	1,880	2,350	2,820	3,290	3,760	4,700	5,640	6,580	7,520
I.H.P.	1·0	1·4	2·3	3·3	4·6	7·8	12·0	16·7	22·0
H P. Friction of Unloaded Engine	·7	·9	1·1	1·3	1·5	2·1	2·6	3·3	4·1

TABLE VII.

PROPELLER B. DATE OF EXPERIMENT: OCTOBER 10TH, 1899.

AIR READINGS.

2 WIDE BLADES. AREA, 175 SQUARE FEET. ANGLE OF BLADES, 12½ DEGREES. AIR DISCHARGED PER MINUTE, 233,231 CUBIC FEET. REVOLUTIONS PER MINUTE, 35. THRUST, 42 POUNDS. INDICATED HORSE POWER, 3·8.

Radius in feet	2	4	6	8	10	12	14	16
Velocity of Air per minute	52	60	267	324	419	368	222	146

TABLE VIII.

PROPELLER E. DATE OF EXPERIMENT: OCTOBER 20TH, 1899.

AIR READINGS.

4 WIDE BLADES. AREA, 350 SQUARE FEET. ANGLE OF BLADES, 21 DEGREES. AIR DISCHARGED PER MINUTE, 363,144 CUBIC FEET. REVOLUTIONS PER MINUTE, 32½. THRUST, 120 POUNDS. INDICATED HORSE POWER, 5·8.

Radius in feet	2	4	6	8	10	12	14	16
Velocity of Air per minute	155	209	363	561	657	724	426	3½

Digitized by Google

NOTES.

The Balloon Ascent from the Top of the Righi.—One of the most remarkable balloon voyages recently undertaken has, undoubtedly, been Captain Spelterini's voyage over the Alps from the summit of the Righi, and it reflects the highest credit on this daring aeronaut. The difficulties of inflating a balloon at a height of 1,456 metres were alone a formidable task, as the balloon and its accessories had to be conveyed by the Arth-Righi Railway, the heaviest item being the 180 steel tubes of compressed hydrogen weighing more than 12,000 kilogrammes. During the inflation of the balloon on the afternoon of July 29th a terrible storm occurred, which in the evening developed into cyclonic violence reported to be unprecedented in these breeding places of storms. Trees were torn up. Telegraph and telephone wires were destroyed, the windows of houses and railway carriages were broken, the harvest was devastated, but the inflated balloon, strange to say, escaped injury owing to the skill of the aeronaut, who passed the night in flattening it against the ground by means of sacks of ballast hung to the network of the balloon. On August 1st the balloon ascended, carrying in the car three passengers—Captain Spelterini, M. Julius Ernst, and M. Emile Gautier. The start was made in a south-west wind, which took the aeronauts right over the large glaciers of the Canton of Glaris. The panoramic view is described as magnificent in an article by M. Gautier in the "Daily Express"—"To the right the whole map of Switzerland, as far as the French and German frontiers, lay spread out like a panorama stretching further than the eye could reach. On our right the whole chain of the Alps from Mount Blanc to the Tyrolean Alps extended their showy crests with the Mer de Glace, which one could see from a height of 4,000 metres. As we advanced we could see all this from another point of view. Soon we entered into the immeasurable. Below us several hundred metres was the famous Gloermisch, the smallest fissures of which could be distinguished under the splendid sunshine. We passed just over the point called Bachislock, leaving a little on one side the Ruche Gloermisch and the Vermelis-Gärtli. It was with inexpressible joy and exultation that we felt ourselves thus soaring above these deserts of ice, untrodden by the foot of man, and upon which no human eye had even looked down. The descent was the most critical part of the voyage. It took place on the Gnuetseven, a peak about 5,200 feet high, and situated in the Canton of Glaris. Monsieur Emile Gautier thus describes the prospect of the desert: "Everywhere peaks, grim and forbidding, rose up like a forest of spikes that offered a foothold to nothing but the chamois. One tiny speck of green, and one only, could be detected." On this tiny speck of green the descent was made. This was in reality a small plateau about 50 square yards in extent, surrounded on every side by abysses that yawned hundreds of feet deep. Monsieur Emile Gautier hardly exaggerated the aeronaut's abilities when he said: "He handles the balloon as easily as if it were a bicycle, and he directed our descent upon the spot selected with the certainty of a marksman aiming at the target."

Wireless Telegraphy Experiments from a Balloon.—According to the "Leeds Mercury," the scientific balloon ascent by the Rev. J. M. Bacon was the most popular item in the programme of the garden party given by the Bradford Corporation at Lister in connection with the meeting of the British Association. The chief feature of the ascent was the experiment in wireless telegraphy, which included an attempt to establish communication with, and receive messages from, a balloon retreating into space. The arrangement for the experiment was that on release the occupants of the car should utilize the first five minutes in lowering their line 150 feet in length and firing a cartridge attached to a tree in the park. The second five minutes was to be spent in sending messages from the earth to the balloon, and the third five minutes in the attempt of the balloonists to send messages to the earth. The first item of the programme was completely successful, the cartridge, which was connected by wire with the receiver, being fired two minutes after the balloon had left the earth. Regarding the other plans the period of five minutes allowed turned out to be too long, for, owing to the brisk breeze blowing, in ten minutes the balloon had become a mere speck as seen from the park, and no messages were received from it. A telegram, however, was received from Mr. Bacon in the evening stating that signals had been received from earth by the occupants of the car at a distance of 20 miles from Bradford.

Fatal Balloon Accident at Naples.—There have been a particularly large number of

successful balloon ascents during the past summer, but the balloon season has not been altogether free from disaster. A fatal balloon voyage was lately reported from Naples by the correspondent of the "Daily News," in which both the aeronaut and a journalist who accompanied him were drowned. On a Sunday evening in July, Captain Venni, accompanied by Count di Montecupo, and a young reporter, Signor Pellizoni, ascended in a balloon from the grounds of the Exhibition in the Villa Communale. The balloon rose to some four thousand feet, and was slowly wafted out to sea. When between Capri and Ischia the aeronaut decided to descend, hoping to make contact with the water near Capri, but he miscalculated the distance and found that they had descended five miles away. When the car dipped into the sea the voyagers clung to the ropes and tried in vain to call the attention of a passing mail boat. For five hours they struggled with wind and wave, but about midnight Captain Venni and Signor Pellizoni became exhausted, let go, and were drowned. The Count di Montecupo, however, managed to keep hold of the ropes and struggled for six hours longer, slowly drifting towards Cape Misenum, where he was rescued by fishermen.

M. Rose's Airship.—Unlike the Zeppelin Airship, M. Rose's flying vessel is based on the principle of being heavier than air. The machine consists of two air-containers of forty-five metres in length, and at their widest eight metres diameter. The machinery and car are placed between the air-containers, which are connected by steel. The whole apparatus is constructed with aluminium tubes, and weighs only 800 kilos. When fully equipped its weight will be 2,200 kilos. Two horizontal screws are provided to raise and lower the airship, and two vertical screws to move it backwards or forwards. These four screws are worked by a petrol motor of 12-horse power. The air condensers are filled with gas to lighten the weight.

The Paris Balloon Contests.—The conditions of the seventh aerial contest held in connection with the Paris Exhibition were that the balloonists were to start from Vincennes and descend at Nanteuil, after previously alighting at Dammartin as a stopping station. Permission was granted the competitors to choose a day when the wind was blowing in the direction required. Only one competitor—M. Jacques Faure—accomplished the conditions of the contest. The rest were blown over Dammartin and Nanteuil without being able to effect a descent there.

M. Santos Dumont's Motor Balloon.—On September 19th M. Santos Dumont made an attempt to win the Grand Prize of the Paris Aero-Club in his motor balloon. The experiment took place in the presence of the members of the International Aeronautical Congress, but a mishap occurred to the steering gear, which put an end to the project of sailing round the Eiffel Tower, though M. Santos Dumont appears to have caused considerable delight to the Aeronautical assembly by giving demonstrations of the motive powers of his balloon against the breeze, the balloon being held by guy ropes. The "Daily Express" thus describes M. Santos Dumont's apparatus: "The balloon proper is elongated, and looks much like a large torpedo. Three feet beneath this hangs the gasoline motor, which is to supply the motive power. The propeller is twelve feet in diameter, and is revolved so rapidly by the motor that the engine frequently gets red hot. The only accommodation for the traveller is a little bicycle seat, from which the aeronaut will direct his motor and steering gear by means of treadles. Then the inclination or declination of his machine must be noted on the spirit levels at his side, and the two hundred odd pounds of ballast must be regulated as the course requires. It need hardly be pointed out after this description that the voyage which M. Dumont is about to undertake is uncommonly dangerous. There appears to be here all the elements of a catastrophe. A red-hot motor within a yard or so of some thousands of cubic feet of hydrogen is enough to give the most stout-hearted the 'creeps,' but M. Dumont makes light of it."

The Paris Exhibition Awards.—The international jury of the Paris Exhibition has awarded Mr. Eric Stuart Bruce an Honourable Mention Diploma for his exhibit of Electrical Balloon Signalling in Group XVIII. (Army and Navy).

Foreign Aeronautical Periodicals.

L'AERONAUTE (Paris).

June, 1900. Séances du 17, Mai et 7 Juin, 1900.—Scaphanche Aéronautique de M. Albut Andrien—Concours Internationaux

Digitized by Google

D'exercices Physiques et de Sports—July, 1900. Séances du 21 Juin et du 5 Juillet, 1900—Eloge de Dagron par M. de Fonvielle. Similitude Mécanique des Corps Plongés.

August, 1900. Séance du 19 Juillet, 1900. Sur les Eclipses par Dorothée Klumpké. Recit d'Ascension.

La France Aerienne (Paris).

15 au 31 Aout, 1900.—L'Aéronautique au jour le jour: Le Capitaine comte Zeppelin Dr. Ox. La Colombophilie au jour le jour: E. Caillé—Concours de ballons à Vincennes. V. Louet—Ascension à Douai: Louis Nopper—Aéronautique et Colombophilie à l'Annexe de Vincennes: La France Aerienne dans la Loire-Inférieure—Nécrologie: M. Adolphe—François Monfallet—Revue de Presse—A la volée—Académie d'aérostation météorologique de France.

1 au 15 Septembre, 1900.—Bulletin météorological Septembre—La Colombophilie au jour le jour. A propos de la dirigeabilité des Aérostats: Roberto Guérin—Les courses de ballons à L'aerodrome de Vincennes—Tableau d'honneur—Colombophilie et tirs aux pigeons—La France Aérienne en Vendée—La France Aerienne en Italie: Catastrophe aéronautique à Naples—La France aérienne en Amérique: Revue de Presse Etrangère—Résultats de concours colomphilie.

L'Aerophile (Paris).

May, 1900.—Portraits d'aéronautes contemporains: M. Victor Silberer (Wilfred de Fonville) L'emploi des cerfs-volants en Météorologie (Jules Vincent) La Catastrophe de Chalais—Meudon (Georges Géo)—Concours d'objectifs a long Foyer Pour la Téléphotographie en Ballon.

Zeitschrift fur Luftschiffahrt und Physik der Atmosphare.

June, 1900.—Captiv-Schraube von Wilh Kress. Apparat Zum Sichtbarmachen der Fadenlinien vei Luftwiderstandserscheinungen, von G. Wellner. Die Flugarbeit, von K. Fuchs—Vereinsnachrichten Deutscher Verein zur Forderung der Luftschiffahrt in Berlin. Protokoll der Versammlung am 28 Mai, 1900—Vereinsfahrten am 28 April 5, 10, 12 und 14 Mai, 1900—Umschav Reglement des Grossen Preises des Aero-Club in Paris.

Illustrirte Aeronautische Mitheilingen. August, 1900. Bericht uber den ersten Fahr-Versuch mit dem Luftschiff des Grafen von Zeppelin.

Notable Articles.

An unusually large number of excellent articles and notes have appeared in the daily press and periodicals during the last three months on aeronautical topics, and it is impossible to mention all of these in the following list. A selection therefore has been made.

July 4. *Daily Mail.*—"Mr. Hiram Maxim on Aerial Navigation."
5. *Daily Chronicle.*—"An Expert's Views on the Future of Flying."
6. *Morning Herald.*—"A New Air Ship."
7. *The Spectator.*—"The Zeppelin Air Ship."
9. *Morning Leader.*—"The Zeppelin Air Ship and its Inventor."
14. *La Nature.*—"The Zeppelin Air Ship."
Illustrated Mail.—"The Great German Air Ship."
18. *Daily Graphic.*—"Castles in the Air."
Morning Post.—"Balloons and Flying Machines."
19. *Times.*—"Aeronautical Experiments."
20. *Standard.*—"Count Zeppelin's Balloon."
21. *Standard.*—"The Scientific Use of Kites."
Illustrated London News.—"Count Zeppelin's Air Ship." (Illustrated.)
Penny Pictorial Magazine.—"How Ballons are Built." (Illustrated.)
28. *The Sphere.*—"Count Zeppelin's Wonderful Air Ship." (Illustrated.)
Madame.—"New Aerial Ships." (Illustrated.)

Aug. *The Strand Magazine.*—"The Zeppelin Air Ship." (Illustrated.)
3. *Standard.*—"A Balloon in a Thunderstorm." Letter to the Editor, by Rev. J. M. Bacon.
4. *The Sphere.*—"Balloons in War Time." (Illustrated.)
9. *Standard.*—"A Balloon in a Thunderstorm." Letter to the Editor, by S. H. Terry.
17. *Daily Graphic.*—"The Balloon Detachment for China. (Illustrated.)
18. *Golden Penny.*—"A Curious Flying Machine."
19. *Daily Express.*—"Balloons in Warfare."
31. *Daily Mail.*—"Mid-Air Signalling."
English Mechanic.—"A Balloon in a Thunderstorm." Letter to the Editor.

Sept. *Pearson's Magazine.*—"The Ship that Flies." (Illustrated.)
4. *Morning Post.*—"Cross Channel Ballooning."
6. *Times.*—"The Balloon Experiments."
7. *Daily Express.*—"Balloon Steering."
14. *News.*—"The Ship of Stars."
25. *La Nature.*—"Concours D'Aerostation."

Applications for Patents.

(From June 1st, 1900.)

The following List of Applications for Patents connected with Aeronautics has been specially compiled for the *Aeronautical Journal* by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.:—

10,021 of 1900. JOHN JONES, 41, Reform Street, Dundee. **Improvements in and Relating to a New and Improved Flying Machine or Airship.**

11,475 of 1900. WILLIAM E. IRISH, 77, Calabria Road, Highbury. **Aeroplanes with Motor and Rudder.**

11,649 of 1900. JOHN JONES, 41, Reform Street, Dundee. **Improvements in Vehicles for Moving Overland or through the Air.**

12,514 of 1900. EMANUEL KALISCH, 19, Holborn Viaduct. **Improved Double-screw Propeller for Flying Machines.***

12,543 of 1900. WILLIAM RICHES, 2, Rose Hill Gardens, Jarvis Brook, near Tunbridge Wells. **Improvements in Aerial Navigation.**

12,844 of 1900. WILLIAM BRAKEFIELD, 3, Churchyard, Ashford, Kent. **Improvements in Flying Machines.**

12,941 of 1900. JOHN JONES, 41, Reform Street, Dundee. **Improvements in and Relating to Aerial Ships or Flying Machines.**

13,138 of 1900. GEORGES HUGHES, 55, Chancery Lane. **Improvements in Aerial Machines.** (Richard Mesch, Belgium).

13,220 of 1900. JOHN JONES and JOHN P. JONES, Sunbrae, Bingham Terrace, Dundee. **A New or Improved Propeller for Flying Machines, Aerial Ships, and Aerial Vehicles, and applied to these.**

13,241 of 1900. CHARLES GROOMBRIDGE and WILLIAM ALFRED SOUTH, 78, Fleet Street, London. **Improvements in Propellers for Use with Flying Machines, Balloons, and the like.**

15,376 of 1900. FELICE TURINA, Birkbeck Bank Chambers, Southampton Buildings, Chancery Lane, W.C. **Improved Means for Steering Balloons.***

Those marked * have been completed.

Those unmarked so are only provisionally protected.

THE

AËRONAUTICAL JOURNAL.

A QUARTERLY ILLUSTRATED MAGAZINE DEVOTED TO ALL SUBJECTS CONNECTED WITH THE NAVIGATION OF THE AIR.

VOL. V

1901.

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & OLDING, LTD., GOUGH SQUARE AND BOLT COURT, LONDON, E.C.

AËRONAUTICAL JOURNAL.

VOL. V.

INDEX.

	PAGE
Aëronautical Society, The, Notices .. 1, 21, 37, 53	
,, ,, General Meetings 22, 38, 53	
,, ,, New Year Honours ..	1
,, ,, The, Work of — Eric Stuart Bruce ..	53
Aëronautical Congress, The Paris International	2
Aëronautical Congress—Presidential Speech ..	4
,, ,, Sectional Subjects ..	5
,, ,, Meetings	32
Aëronautical Commission, The International Permanent 5, 68	
Aëronautics in France—Wilfred de Fonvielle	38
Air-Ship, New—Suter	51
,, W. Beedle's	70
,, Dr. Barton's	69
,, F. Buchanan's	69
Air-Ship, Zeppelin, Experiments with ..	25
Air Sounding—Patrick Y. Alexander .. .	59
Ascents, International 33, 49	
,, Notable British—Percival Spencer ..	45
,, Dr. Berson's Recent High	68
Angle of Incidence—Wilbur Wright (Diagram)	47
Andree's Message	16
Balloon Ascents, The International—P. Y. Alexander	14
,, ,, Value of Pure Oxygen ..	17
British Ballon Sonde, First Record (Diagram)	15
Balloon, The Great Berlin	16
Balloons, Effects of Vertical Aerial Currents on	33
Balloon Trip	33
,, Voyage Across Atlantic	50
Bruce, Eric Stuart	43
,, Helen Auxilium	7
Barton, Dr.	50
Balloon, The, Railway	50
Balloon, Navigable—Santos Dumont's (Illustrated) 6, 62	
,, Race—Competitors (Illustrated) ..	7
Competitions, The Vincennes—Helen Auxilium Bruce (Illustrated) 7, 43	
Coin, The Sparrow Balloon	64
Congress, The Paris. Some Celebrities—	
M. Janssen	9
Major F. C. Trollope	11
M. Wilfred de Fonvielle	12
M. Jacques Faure	13
M. Louis Triboulet	14
Mr. Abbott Lawrence Rotch	24
Discourses, Royal Institution—G. H. Bryan ..	18
Dragon Flyer, The Kress	27
Exhibits, Aëronautical—Royal Institution ..	34
,, ,, Crystal Palace ..	49
England—Descent of French Kite	16
French Kite—Descent in England	16
Fitzgerald, G. F., Professor—Death of ..	35
Fonvielle, Wilfred de 38, 63	
Flying Machine—Zimmerman's "Cycala" ..	50
,, ,, Barton's	50
Flight—Remarkable Kite	50
Flying Machine, Hofman (Illustrated) ..	60
France, Aëronautics in—Wilfred de Fonvielle	38
Honours, New Year	1
High Ascent, Dr. Berson's Recent	68
In Memoriam	23
Kites, Chief Scientific Uses—A. Lawrence Rotch	56
,, Rotary	60
,, Systematic Exploration of Atmosphere	69

INDEX—*continued.*

PAGE

London, The Dust Floating Above 70
,, Institution Lectures—Eric Stuart Bruce, Esq. 18

Message, Andree's 16
Machines, Soaring 34
Meteo-Parachute, The—Eric Stuart Bruce .. 43

Navigable Balloon, Santos Dumont's (Illustrated) 6, 62
,, ,, "La France" 34

Paris Congress—The Sectional Subjects .. 5
,, Some Celebrities :—
M. Janssen 9
Major F. C. Trollope .. 11
M. Wilfred de Fonvielle .. 12
M. Jacques Faure .. 13
M. Louis Triboulet .. 14
Mr. Abbott Lawrence Rotch 24
Paris, Echoes of the Siege of 44
Photography, Balloon at Great Altitudes—Percival Spencer 61
Prize, The Deutsch 70
Parachute, The Meteo—Eric Stuart Bruce .. 43

Race, The Great Balloon—The Competitors—Helen Auxilium Bruce 7

PAGE

Reviews Vertical Gradients of Temperature, Humidity, and Wind Direction 27
,, Sounding the Ocean of Air . .. 29
,, By Land and Sky 31
,, Aerial Navigation 67
Records, Kite Flying 35
Royal Institution—Discourses 18
Rotch, A. Lawrence 56

Spencer, Percival 45, 61
Suter, Henry 51
Systematic Exploration of the Atmosphere .. 69
Soaring Machines 34

Voyage Across the Channel 70
,, ,, Atlantic 50
Vertical Aerial Currents on Balloons, Effects of 33
Vincennes, The Competitions—Helen Auxilium Bruce 7
Value of Pure Oxygen, The, in High Balloon Ascents 17

War Balloon, The History of 16
,, Balloons, Italian Experiments in Firing 17
Wright, Wilbur 47

Zeppelin Air-Ship, Experiments with 25
Zimmerman, Dr. C. 50



20:5
245

Special Illustrated Paris International Aeronautical Congress Number.

ENTERED AT STATIONERS' HALL.] PRICE, { TO NON MEMBERS AND NON-ANNUAL SUBSCRIBERS } 2s.

UNIV. OF MICH.
AUG 4 1910

THE AERONAUTICAL JOURNAL



Edited for the Council of the Aeronautical Society of Great Britain

By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 17. JANUARY, 1901. VOL. V.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	1
THE PARIS INTERNATIONAL AERONAUTICAL CONGRESS	2
THE PRESIDENTIAL SPEECH	4
THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS	5
THE PERMANENT INTERNATIONAL AERONAUTICAL COMMISSION	5
M. SANTOS DUMONT'S NAVIGABLE BALLOON. BY A MEMBER OF THE PARIS AERO-CLUB (*Illustrated*)	6
THE VINCENNES COMPETITIONS. BY HELEN AUXILIUM BRUCE (*Illustrated*)	7
SOME CELEBRITIES OF THE PARIS CONGRESS	9
1. M. JANSSEN (*Portrait*)	9
2. MAJOR F. C. TROLLOPE (*Frontispiece*)	11
3. M. WILFRED DE FONVIELLE (*Portrait*)	12
4. M. JAQUES FAURE	13
5. M. LOUIS TRIBOULET (*Portrait*)	14
THE INTERNATIONAL BALLOON ASCENTS. COMMUNICATED BY P. Y. ALEXANDER (*with Diagram*)	14
NOTES: THE FRENCH KITE WHICH FELL IN ENGLAND—ANDRÉE'S MESSAGE—THE GREAT BERLIN BALLOON—THE HISTORY OF THE WAR BALLOON—THE ITALIAN EXPERIMENTS IN FIRING ON WAR BALLOONS—THE VALUE OF PURE OXYGEN IN HIGH BALLOON ASCENTS—LONDON INSTITUTION LECTURES, MODERN AERONAUTICS—ROYAL INSTITUTION FRIDAY EVENING DISCOURSES, THE HISTORY AND PROGRESS OF AERIAL LOCOMOTION	16-18
PUBLICATIONS RECEIVED	18
APPLICATIONS FOR PATENTS	18

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL, & RAILTON, LTD., GOUGH SQUARE AND BOLT COURT, E.C.

Google

AUGUSTE E. GAUDRON,

Aeronautical Engineer.

MANUFACTURER OF

GOLDBEATERS' SKIN (BEAUDRUCHE), SILK, & CAMBRIC BALLOONS

For Private and Military Purposes.

Experiments Conducted on Large and Small Scale.

GOLDBEATERS' SKIN MODEL BALLOONS FOR PRIMARY EXPERIMENTS.

PRIVATE AND SCIENTIFIC ASCENTS CONDUCTED.

Mr. Gaudron begs to inform inventors that he has at their service a large works, suitable for any kind of Aeronautical experiment; also a trial ground with gas, &c.

AUGUSTE E. GAUDRON,

Aeronaut and Balloon Manufacturer

7, VICTOR ROAD, LONDON, N.

Registered Telegraphic Address: "GAUDRON, LONDON."

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers,

Messrs. KING, SELL, & RAILTON, 4, BOLT COURT, LONDON, E.C.

Digitized by Google



MAJOR F. C. TROLLOPE.

(Late Grenadier Guards),

DELEGATE OF THE BRITISH GOVERNMENT AT THE PARIS INTERNATIONAL AERONAUTICAL CONGRESS.

Digitized by Google

THE AERONAUTICAL JOURNAL.

JANUARY, 1901.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL, & RAILTON, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road, Kensington, London, W.

NOTICES OF The Aeronautical Society.

A meeting of the Council was held on September the 25th, when the following gentlemen were elected Members of the Society :—

MR. WILLIAM FRANCIS COOPER, B.A.

MR. CHARLES J. DAVIES.

The next General Meeting of the Aeronautical Society will be held in the rooms of the Society of Arts, John Street, Adelphi, in April next, the date of which will be duly announced.

For this occasion Monsieur Wilfred De Fonvielle, late President of "La Société Française de Navigation Aerienne," will come specially from Paris to London to address the Members of the Aeronautical Society of Great Britain (in English).

Monsieur Jacques Faure (the Treasurer of the Paris Aero-Club), who will also come specially from Paris, will read a paper on "Nautical Ballooning."

Mr. Charles Groombridge (Member of the Aeronautical Society), will exhibit and explain his new Propeller for Aeronautical Purposes.

There will be a demonstration of the "Meteoparachute," a new instrument for investigating the upper atmosphere, by Eric Stuart Bruce, Esq., M.A., F.R.Met.Soc.

During the evening a series of lantern slides illustrative of the trial trips of the Zeppelin Airship and M. Santos-Dumont's Navigable Balloon will be projected on the screen.

Members are reminded that they have the privilege of introducing two friends to the General Meetings of the Society.

Members and Correspondents of the Aeronautical Society are reminded that the present address of the Aeronautical Society is 19, Campden House Road, Kensington, London, W., and that all communications should be addressed to the Honorary Secretary to that address.

ERIC STUART BRUCE,
Honorary Secretary.

THE NEW YEAR HONOURS.

THE Members of the Aeronautical Society of Great Britain will unite in congratulating Sir Hiram Maxim, a Member of the Council of the Society, on the honour of Knighthood which Her Majesty has been pleased to bestow on him in recognition of his distinguished services in the cause of Scientific Invention. Sir Hiram Maxim has won world-wide renown for the auto-

Digitized by Google

matic gun which bears his name, but perhaps it is his Flying Machine that will secure him still more enduring fame. It may be said without exaggeration that Sir Hiram Maxim has done more than any other experimenter to show the world one possible future of air navigation by machines that are heavier than air, and all his work has been based on sound scientific principles. Perhaps one of the most commendatory features concerning his aeronautical researches has been the absence of any sensational element, which has often in the past characterised the too premature efforts of the enthusiastic, and ended in both failure and tragedy.

The Editor much regrets that the portrait and biographical sketch of Mr. A. Lawrence Rotch, the originator and director of the Blue Hill Meteorological Observatory, and who was one of the official delegates representing the American Government at the Paris Congress, was received too late for insertion in this number. They will, however, duly appear in the next number.

The Paris International Aeronautical Congress.

The Paris International Aeronautical Congress, which, under the Presidency of M. Janssen, was held at the Meudon Observatory last September, and which attracted distinguished representatives in Aeronautical Science from the principal countries of the world, was an undoubted success. It is however, to be regretted that Great Britain contributed comparatively few names to the list of the members of the Congress, and that our own Aeronautical Society was not more largely represented. The importance of the Congress was, however, fully realised by the British Government, who, in the midst of the stress and strain of having several balloon equipments engaged in the great struggle in South Africa, and sending another to China, yet did not neglect to send a delegate to represent the British Government at this important international meeting—a delegate so versed in practical ballooning as Major Trollope, the present acting superintendent of the balloon factory at Aldershot, whose portrait and biographical sketch appear on the pages of this Congress number of the journal.

Perhaps the explanation of a deficiency in the number of British savants who attended the Congress is explained by the fact that the practical British nation has not yet thoroughly realised that there are a sufficient number of practical issues likely to arise from the study of aeronautics to justify a lavish expenditure of its intellect and skill. But even if aerial locomotion seems yet but a distant dream, and the fancied delightful independence of the truly navigable balloon and flying machine are far from realisation, still, there are other eminently practical advantages to be gained by the pursuit and practice of aeronautics. Putting aside the great and important use of the balloon as an addition to our national defences in military and naval service, let us consider the application of the science of aeronautics to the extension of meteorology. Aeronautics alone can provide the instruments to grapple with the great unknown problems of the upper atmosphere. The newer meteorology is, in fact, dependent on aeronautics for its existence as a science for terrestrial meteorology is only a limited branch of the great science of the aerial ocean. Useful, indeed, is the latter, as it deals with those climatic influences which, owing to terrestrial interferences with atmospheric laws, act for weal or woe upon mankind; but researches in the former can alone impart a knowledge of the laws that regulate the complex vertical and horizontal motions of the atmosphere of our planet. But to what practical purpose could such a store of knowledge be applied. One probable practical result may be cited as being worthy of the energy of a nation which only needs to clearly see the practical, and to devote to it its characteristic energy. That is the attainment of long and certain weather forecasts in place of short and uncertain ones. Thousands of other practical issues hang upon forecasting the weather aright. What disasters at sea might be averted if mariners had longer warnings of those periodic gales which strew the shores

Digitized by Google

with shipwrecked vessels. How advantageous to the farmer it would be if he had longer foreknowledge of thunderstorm which follows the spell of drought, which floods the fields of new-mown hay, and stops short the ingathering of the harvest. Or still more beneficial to mankind would be predictions of the furies of tornadoes and whirlwinds.

If ever such prophetic skill is the attribute of man, it will be acquired by the high flights of recording balloons and kites into the upper atmosphere.

Though the Paris Congress largely dealt in its sections with the problem of aerial locomotion, yet the new application of scientific kite-flying to atmospherical research was largely dealt with, and this part of the programme might well have attracted a large and representative contingent of British meteorologists. In kite-flying, America has taken the lead, and high-kite flights have there become the recognised method of attaining a knowledge of the upper atmosphere. Therefore, it was, perhaps, not surprising that this country supplied the Congress with no less than five delegates representing their Government. In reference to American kite-flying, attention may be drawn to the report of the kite observations of 1898, published by the United States Department of Agriculture, to be reviewed in the next issue of this journal. Equally important as scientific kite-flying though as yet not so developed are the ascents of the "ballons sondes," or, as they may be otherwise called, self-recording balloons. These carry no passengers, only the self-recording instruments—barometers, hygrometers and thermometers. Consequently they can attain very high altitudes in such a rarefied condition of atmosphere, as no human explorer could possibly survive. For instance, in April 1895, the Cirrus rose to 72,000 feet, which is over 13½ miles, and where the barometric pressure was reduced to one and a half inches of mercury. In recent years, ascents by these "ballons sondes" in various countries have formed part of the programme of the International Aeronautical Commission, and it has been in the past a reproach to this country that we have not shared in these aeronautical experiments that have simultaneously been conducted in Paris, Brussels, Berlin, Warsaw, St. Petersburg, Strasburg, Munich and Vienna. One beneficial result of the late Congress is that this reproach is now removed from Great Britain, as our country has now undertaken to assist in this important aeronautical and meteorological effort. In another part of this journal will be seen the record of the first ascent of a "ballon sonde" in England at Bath, the ascent being conducted by Mr. P. Alexander, who is undertaking these ascents for this country.

The diversified programme of the Congress reflects the highest credit on its organisers. The proceedings extended from September 15th—21st. The afternoon of the 15th was devoted to the opening meeting, including the Discourse of the President. On the morning of the 16th the work of the sections was commenced at the Institute de France. In the afternoon at the annexe of the exhibition at Vincennes, there was the reception of the members of the Congress by the organising committee of the Aeronautical Competitions at Vincennes. There was also the balloon competitions in the "Parc d'Aerostation." On the morning of the 17th, there was a discourse by Commandant Paul Renard on "The Present Position of Aeronautics" in the Meudon Observatory. In the afternoon a visit was made to the aeronautical section of the exhibition, and an ascent of the Eiffel Tower was made. On the 18th, in the morning, there were discourses by M. Teisserenc de Bort, M. Assmann of Berlin, M. Rotch of Blue Hill. In the evening the members of the Congress paid a visit to the Chateau of Chantilly. On the 19th, the morning was devoted to a visit to the meteorological observatory at Trappes.

In the afternoon, M. Santos Dumont gave a demonstration of his navigable balloon in the "Parc d'Aerostation" of the Aero-Club. In the evening there was a soirée and reception of the members in the salons of the Aero-club. This reception was one of the most brilliant features of the Congress, speeches being made by M. le Comte de La Valette, M. Janssen, Commandant Paul Renard. There were also admirable discourses by Mlle. Klumpke, M. Henry Deutsch de La Meurthe, and M. Emmanuel Aime.

On September 20th, the work of the four sections was resumed. In the afternoon the members made an excursion to the Central Military Aeronautical Establishment at Chalais. On the 21st the business of the sections was concluded. In the afternoon the closing meeting was held at the Meudon Observatory, when the Permanent International Aeronautical Commission was nominated. In the evening there was a banquet in the Orangery at Meudon. This finally concluded the gathering of the world's aeronauts. The banqueting hall had been most fitly selected

Digitized by Google

for its historical associations. Here it was that the first military balloons of the first Republic were constructed under the direction of Coutille and de Comte.

It will be seen that the programme of the Paris Aeronautical Congress, while it devoted so many hours to the vigorous discussion of those scientific problems which it is the aeronaut's aim to solve, did not neglect to provide pleasant recreation and opportunities of friendly intercourse so essential to the success of international gatherings.

The Presidential Speech.

Monsieur Janssen commenced his presidential oration by complimenting the organising committee on the zeal they had displayed in preparing the International Aeronautical Congress, and he gave a hearty welcome to the strangers of all nationalities who had so cordially responded to the invitation to take part in its proceedings. He then gave a sketch of the progress made in aeronautical science since the last International Congress held in Paris in 1899. He pointed out that it was the necessities of the Siege of Paris in 1870 that inspired fresh attention to the use of balloons and pigeons in warfare, a use which had been quite overlooked in France since the First Empire. The Government was not long before it occupied itself with the organisation of a special military balloon and pigeon service. For this purpose was the fine establishment at Chalais organised, where not only balloons and their accessories are manufactured and the necessary instruction for their management in warfare imparted, but where, also, opportunities can be given for a close study of the possibilities of improvement in aeronautical machinery and accessories. Though France led the way in military ballooning, several other European nations—Germany, Russia, Italy, and Great Britain—soon followed its example, with the result that several important improvements have been made which have tended to enhance the importance which military balloons now possess. One fact is worthy of mention. This is the loan of the military balloons in Germany and Russia for the purpose of scientific investigation.

Military ballooning is destined to play a great part in the warfare of the future, and, already, the recent American and Transvaal Wars have been object lessons in showing the usefulness of the balloons to the generals in command.

Though, thus speaking in praise of the recent advances in military ballooning, M. Janssen did not fail to point out that after all the great desideratum of the balloon has yet to be discovered, viz., its navigation.

Since 1839 this great problem has incessantly occupied the attention of the aeronaut; but, it has to be confessed that in spite of the interesting experiments that have been carried out, and which have been worthy of all encouragement, no decisive solution of the problem has been made. In Berlin two very daring experiments have ended in a tragedy. But these failures have by no means discouraged further experiment. Examples of fresh enterprise are afforded in the experiments of M. Santos Dumont, who is striving after the prize of 100,000 francs founded by M. Deutsch, and in Count Zeppelin's experiments on the Lake of Constance with his extraordinary elongated airship of 117 metres long and propelled by two petroleum engines which act on four screws.

M. Janssen reminded his hearers that the direction of the balloon against the wind was the first and most important problem the aeronaut had to solve; still, other points were of great importance, such as the attainment of great heights in balloon ascents, remaining in the atmosphere without descending for as long a time as possible, and the accomplishment of very long journeys.

As an example of height attained, he quoted the record of M. Berson, who attained a height of more than 9,000 metres with the help of the inhalation of oxygen. As an example of distance attained, he drew attention to the journey of Count de Castillon de Saint Victor from Paris to Sweden, when he covered a distance of over 1,300 kilometres. As an example of duration he cited the journey of Count de La Vaux who was 30 hours in his balloon without touching the ground. He also mentioned the journey of M. Mallet, who, in eight days, made a tour of France in the same balloon, though the journey was broken with descents. But, as will be seen in another article in this journal, the record of distance and duration mentioned in the President's address has been beaten since its delivery.

M. Janssen emphasized the importance of the recent scientific balloon ascents that have taken place in Germany under the auspices

of the Berlin Aeronautical Society. During the last five years, no less than 75 such ascents have been carried out.

The President made graceful allusion to the memory of those aeronauts which the world has lately lost. Eugene Godard, the instigator of the balloon service during the Siege of Paris; Hureau de Villeneuve, who founded the journal l'Aeronaut: Gaston Tissandier the patriotic aeronaut of the armies of La Loire, the witness of the terrible drama of the "Zenith," and the founder of that valuable journal "Na Nature"; lastly, Coxwell, the famous aeronaut who piloted M. Glaisher in his scientific ascents.

In concluding his speech, M. Janssen, in eloquent language, drew a picture of the supremacy that nation would have who would be first master of the aerial ocean—a picture fearful to contemplate. But to modify the horror of the possibilities of aerial warfare—the "ghastly dew from the nations' airy navies grappling in the central blue." M. Janssen held out the fervent hope that by the time the conquest of the air has been completed, man will have reached such a finesse of civilization, that it will have resulted in the pacification of nations.

The Sectional Subjects at the Paris Congress.

It is impossible, through want of space, to give a complete list of the various papers read and discussed at the Aeronautical Congress, and it must suffice to give the titles of some of the most important.

SECTION I.

AÉROSTATION.

Thermosphère Dirigeable.—*Aimé.*

Navigateur à Poche Natatoire.—*Bonneil.* Déviation des ballons par les guideropes drouillard.

Signaux à Grande Distance à bord des Aérostats libres ou captifs.—*Dibos.*

Stabilité Statique.—*Hervé.*

Production de l'Hydrogène.—*De Tomilowski.*

SECTION II.

AVIATION.

Note sur l'Aviation Militaire.—*Ader.*

Force des Hélices.—*Alexander.*

Le Dynamoptère.—*Berthenson.*

Etude sur le Vol Plané.—*Bretonnière.*

Etude sur la Resistance de l'Air.—*Clerc.*

Expériences sur la Resistance des Fluides.

SECTION III.

INSTRUMENTS.

Les Voyages Aériens Scientifiques.—*Assmann.*

Theorie de la Formation de l'Auréole.—*Bouquet de la Grye.*

Ballons Lumineux aux Signaux.—*Bruce.*

L'Auréole de Aéronautes.—*De Fonvielle.*

Le Service de Cerfs Volants à Blue Hill.—*Rotch*

Photogramétrie.—*Triboulet.*

SECTION IV.

LEGISLATION.

Du Rôle des Aérostiers lors de la Campagne d'Egypte.—*De Villiers.*

Des Devoirs des Aéronauts.—*J. Faure.*

The International Permanent Aeronautical Commission.

The composition of the International Permanent Aeronautical Commission elected at the close of the Paris Congress is as follows:—

President:
M. JANSSEN.

Vice-Presidents:
MM. MAREY, COLONEL CHARLES RENARD.

General Secretaries:
M. L. TRIBOULET and M. HENRI HERVÉ.

Secretary of Meetings:
CAPT. VOYER.

Treasurer:
M. CASSÉ.

Foreign Vice Presidents:
Russia, GENERAL RYKATCHEFF.
Germany, M. HERGESELL.
United States, M LANGLEY.

Foreign Secretaries:
Great Britain, M. PATRICK ALEXANDER.
Germany, M EMDEN.
Italy, MM. SCHIAVONE, LE CHEVALIER PESCE.

Digitized by Google

French Members:

M. Teisserenc De Bort, Commandant Hirschauer, Comte de la Vaux, Comte de la Vallette, Commandant Paul Renard, M. Hervé, Lieutenant de Vaisseau Tapissier, M. Surcouf, M. La Chambre, M. Mallet.

Foreign Members:

Mr. Rotch (America), MM. Assmann, Moedebeck (Germany), Major Trollope (Great Britain), Commandant Hintertoiser (Austria), Commandant Millard (Belgium), M. Canovetti (Italy), Professor Joukowki (Russia), Colonel Struhi (Switzerland).

The Permanent Aeronautical International Commission in its meeting of Dec. 20th at the Institute, nominated several sub-committees to examine the resolutions made by the Congress of 1900.

These resolutions concern principally—1 The employment of those astronomical methods which permit of the work being done in a balloon; 2 The precautions to be taken in the preparation and execution of long aerial voyages; 3 The means of preventing accidents of poisoning by impure hydrogen; 4 The establishment of an international association to safeguard the interests of aeronauts in all countries.

Other sub-committees to consider the remaining resolutions of the Congress will be nominated at a future meeting.

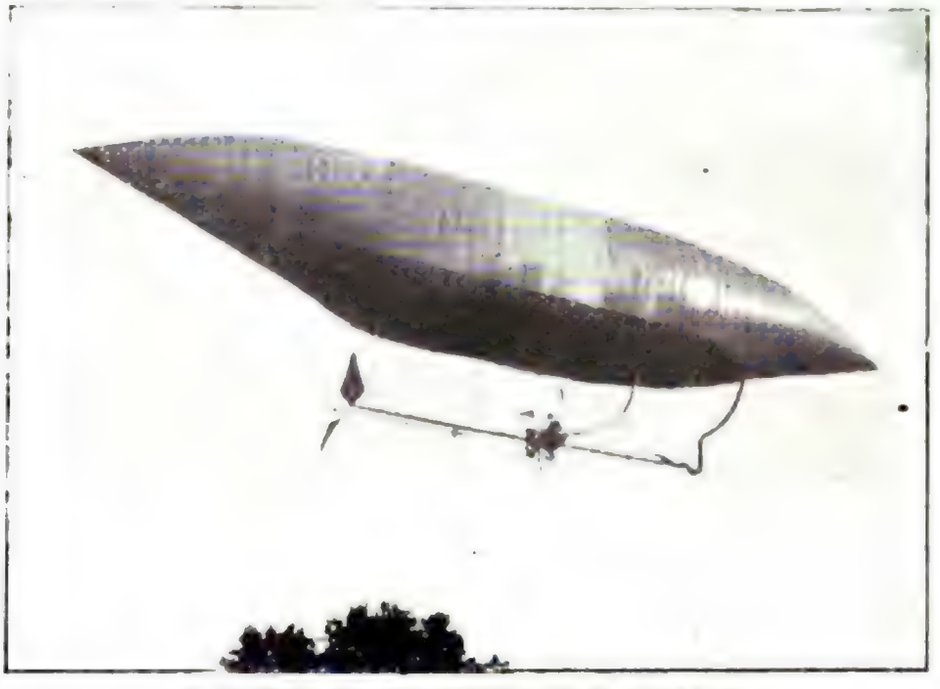
The Permanent Commission at its first sitting on the 8th of December, nominated the sub-committee of the "Aeronauts' Certificates," a most important safeguard for aerial travellers, whose numbers increase daily.

The Committee has further decided to supply those newspapers who may wish for it with an official account of each of its meetings.

Mr. Santos Dumont's Navigable Balloon.

By a Member of the Paris Aero-Club.

In the notes of the last number of this journal, mention was made of M. Santos Dumont's unsuccessful attempt to win the Grand Prize of the Paris Aero-Club. By the courtesy of the editor of the "Illustrated Mail," we are enabled to reproduce an excellent picture of this new navigable balloon. The following details of its construction may be of some interest to our readers.



M. SANTOS DUMONT'S NAVIGABLE BALLOON.
(By kind permission of the Editor of the "Illustrated Mail."

The elongated balloon has a capacity of 334 cubic metres. The surface of the balloon comprises 292 square metres. Its length is 28 metres 50 centimetres. Its diameter surface is 21 square metres. The bicycle seat on which the aeronaut sits is suspended 5 metres 30 centimetres below the centre of the balloon. The material of the balloon is Japanese silk. It weighs 57 kilos, which includes the weight

Digitized by Google

of the inner air chamber of 35 cubic metres volume. The weight of the ropes and tackle is 6 kilos. The screw is made of aluminium and steel covered with silk. This is four metres in diameter. Its weight is 27 kilos, and it makes 100 revolutions a minute. It is worked by a ten-horse power motor. There is a rudder 6 metres 50 centimetres in surface. This works on a hinge attached to the balloon.

The valvular arrangements are somewhat complicated. There is an upper valve for regulating the vertical motions of the balloon. This is 49 centimentres in diameter. There are two lower valves provided for automatically regulating the escape of hydrogen at a pressure of 15 millimetres and 18 millimetres of water. The diameter of these valves is 20 centimetres. Then there is another lower valve of the same diameter which automatically regulates the outflow of air from the inner air chamber at a pressure of 9 millimetres of water. The air is driven into the air chamber by means of a fan worked by the motor. The presence of this inner balloon secures the retention of the shape of the balloon by keeping up a normal tension of the envelope. This preservation of the shape of the balloon is considered essential, as it facilitates the motion of the balloon through the air.

The Vincennes Competitions.

By Helen Auxilium Bruce.

Communication from the Aero-Club, of Paris.
October 5th, 1900.

"The first French balloon voyage to Russia, a distance of 1,300 kilometres in 21 hours.

"Comte Henri de la Vaulx communicates to the Aero-Club the synopsis of his voyage to Russia in the balloon 'Centaur' of 1,600 cubic metres. Starting alone in his balloon, as did also the Comte de Castillon de St. Victor and M. Jacques Faure in the balloons 'L'Orient' and 'L'Aero-Club,' he found his level between 2,000 and 3,000 metres, and through the night flitted above a sea of clouds. In the morning he dropped a little and recognised the plains of Germany; then the 'Centaur,' under the heat of the Solar rays, rose up again into the higher regions, and at 2.15 in the afternoon came to land gently, outside Wocawek in Russian Poland. The 'Centaur,' with the flight of a bird, had travelled over 1,300 kilometres.

"When M. de la Vaulx landed he still had 100 kilos of ballast and could have travelled further, but he was afraid of coming down in an uninhabited Russian steppe, and of not getting back to



THE COMPETITORS IN THE GREAT BALLOON RACE OF OCTOBER 9TH, 1900.

By kind permission of the Editor of the "Illustrated Mail.")

Digitized by Google

Paris in time for the champion race of the next Sunday. So he decided to land by a town, and it was fortunate he did so, for, in spite of having the railway and telegraph at hand, he was kept prisoner for over 24 hours, while the Governor-General of Varsovie obtained his instructions and gave the necessary orders to permit of his recrossing the frontier. Had M. de la Vaulx journeyed further, he would have fallen on the desert lands beyond the governorship of Varsovie, he would have had to obtain the necessary permit for return from headquarters at St. Petersburg, and his arrival in Paris would certainly have been very much delayed. He relates that his captivity was light and easy, and that the friendly Russian authorities fêted his unexpected arrival in the allied country by numerous bottles of champagne and other wines.

"This journey is another active success for the Aero-Club, one of whose balloons for the first time has united right across the vastness of Germany, the two nations who are already one in the bonds of friendship.

The General Secretary,
EMMANUEL AIME."

The interesting communication, which I have just translated above, from the Secretary of the Aero-Club, was at the moment of its reception considered the distance feat of the Vincennes competitions, almost rivalling that of 1899 of Comte de Castillon de St. Victor and M. Mallet—Paris to Sweden, 1,335 kilometres in 24 hours. Since then it has been beaten by a record of both distance and time of remaining up, which has obtained for Comte Henri de la Vaulx the Grand Prize for aeronautics of the Exhibition.

Practical persons, when considering the Aeronautical Congress, turned with greatest interest to the Vincennes Competitions. These competitions in the Aerostatic Park of the Universal Exhibition, were arranged by the organisation committee of section X, and were announced in the issue of the "Aeronautical Journal" of last July. There were fourteen balloon competitions between the 17th of June and the 9th of October. There were 158 ascensions and no accidents. 325 persons ascended.

Though the competitions were international, all the balloons were French. And in view of the results obtained, France may well be gratified, and other countries feel regret that they were unrepresented. The record of the world for distance travelling and for length of staying-power was obtained a sum of experience which must bear fruit, and an accumulation of scientific observations of the value and place of which it is as yet premature to decide. Of course, Great Britain, with wars upon her hands, and many of her leading aeronauts in the field, was not in a position to attempt to share in the French enterprise; and to those who know what practical ballooning is, it is a continual marvel that Great Britain has done what she has, evolved the finest practical balloon material, a system of signalling, and a working military balloon establishment, handicapped as she is by her geographical position. Anyone who goes up in a balloon in England for a voyage of any respectable distance, runs a fair chance of passing the night in the sea, and our weather of samples supplies a wind variation that calls ceaselessly on the national fund of doggedness and patience when planning ascents in advance. Those who ascend in balloons on the European continent, on the contrary, may calculate on the risks of land descent rather than on the yielding watery grave.

The long distance record was obtained on October the 9th by Comte Henri de la Vaulx, who landed in Russia, at Korosticheff, a distance of 1,925 kilometres in 35 hours 45 minutes. M. J. Balsan and Louis Godard, on the same day, also beat the previous distance record of 1899, descending at Rodom in Russia, a distance of 1,360 kilometres in 27 hours 15 minutes.

The distance competitions of August 12th and August 26th were cut short by arrival at the sea.

In the three altitude competitions, nearly all the balloons descended in the department of Marne; this is considered by M. Eugene Godard to indicate in the higher atmosphere a persisting current to the east. What light we want on the currents of the higher atmospheres! Here is all the secret of a practical system of ballooning! The two highest altitudes of these competitions were obtained on the 23rd of September by M. J. Balsan and Louis Godard, 8,417 metres, with a difference of less than 42 degrees Centigrade, and M. G. Juchmes with 6,877 metres.

The winds, most frequent on the days of competition, were between west and south-west.

The ascent of the 16th of September, saw no less than 26 balloons with a tonnage of 23,311 cubic metres of gas.

The greatest speed was obtained by M. de la Vaulx on the 26th of August, when he traversed 42 kilometres with a speed of about

Digitized by Google

62 kilometres an hour (17 metres a second). and slowness of speed was the appanage of M. G. Juchmès, who, on the 16th of September, went 30 kilometres only in 16 hours 5 mins., less than 2 kilometres an hour.

For staying power in the air, M. Jacques Balsan, on the 16th of September, ran up very close to M. de la Vaulx's later Russian record of the 9th of October. M. de la Vaulx's record was 35 hours 45 mins. without a descent, while M. J. Balsan's was 35 hours 9 mins. in his journey from Paris to Belgium.

At the head of this article is an illustration of some of the competitors in the long-distance race of the 9th of October, which, by the courtesy of the editor of the "Illustrated Mail," I am able to reproduce. Reading from left to right, the 2nd in the group is M. Hervieu; No. 3 is M. Balsan; 4 M. Jacques Faure; 5 Le Comte H. de la Vaulx; 6 M. Juchmès; 7 M. Maison. M. Jacques Faure was 3rd in the long-distance competitions of 30th September and 9th of October. He is another illustrious member of the Aero-Club, and a notice of him appears in another portion of this journal.

The Aero-Club, the child of the Automobile Club, is just now one of the most living powers of aeronautics. The scientific records of its members are expanding the confines of our knowledge of meteorology, astronomy, and aeronautics. In two years 20 balloons have been made for members of the Aero-Club, and 300 ascents have been carried out. Its President is M. le Comte de Dion, and its Secretary is M. Emmanuel Aimé, who sent to the Secretary of the British Aeronautical Society the communication with which this article opens.

M. Aimé is the inventor of the thermosphere. The thermosphere is a balloon partially filled with hydrogen, which is expanded and condensed at will by the introduction of steam, heated by petroleum in the car, with the object of regulating without sacrifice the vertical motion of the balloon. M. Aimé has always persistently advocated the use of the vertical motion of the balloon so as to utilise the various layers of horizontal currents. He first brought forward his views at the Aeronautical Congress in 1889, and since then has been at work in endeavouring to practically further them. The scientific world is awaiting, with interest, the trial of the thermosphere.

In addition to the balloon competitions at Vincennes, there were kite competitions, but the wind was capricious, and dropped on two of the occasions when the kites were admitted. Nevertheless, M. Teisserenc de Bort, with an admittedly inferior kite, beat Mr. Rotch's present Blue Hill height record of 4,815 metres by getting his kite up to 4,900 metres.

Some Celebrities of the Paris Congress.

1.—M. JANSSEN.

It is with much satisfaction that we present to our readers a reproduction of the excellent portrait of M. Janssen, which that illustrious scientist has recently presented to the Aeronautical Society of Great Britain. The Paris Congress was certainly to be congratulated on having secured for its President one so distinguished in original research and discovery as the Great French Physical Astronomer.

M. Janssen was born in Paris on February 22nd, 1824. He is the son of an eminent musician, Antoine Cesar Janssen. It was in his thesis for his degree of doctor of science, that his subtle originality was first prominently displayed. In that work he pointed out the important fact of the absorption of heat rays by the eye. The master work of the philosopher has undoubtedly been his contributions to new knowledge in spectrum analysis, and at an early stage in his career he showed the part that the terrestrial atmosphere plays in the production of the lines of the solar spectrum—a discovery which so impressed the French Academy, that M. Janssen was sent to Italy by that body in 1862, so that he might pursue his investigations in an advantageous climate.

In further pursuit of fresh evidence, M. Janssen, in 1864, spent a week at the summit of the Faulhorn, and by actual experiment at the Lake of Geneva, confirmed the terrestrial origin of certain lines. Soon after these discoveries, M. Janssen proved that some of these were due to the presence of water vapour in the atmosphere. This discovery of the spectrum of water vapour was exceedingly important, as, by its means, it has been found possible to ascertain the existence of water in the atmospheres of the planets and stars. The work of finding water in the atmosphere of Mars was accomplished by M. Janssen, and this was the first contribution to our know-

Digitized by Google

ledge of the chemical constitution of a planet's atmosphere.

In 1868, M. Janssen went to India to observe the greatest eclipse of the century, and apply the principles of spectrum analysis to eclipse phenomena. It was during this expedition that he discovered the well-known method which rendered it possible to take several observations of solar prominences and other coronal phenomena without waiting for the rare moments of eclipse.



MONSIEUR JANSSEN.
(President of the Paris International Aeronautical Congress.)

At another eclipse in 1871, M. Janssen discovered in the Nilgherry Mountains a new solar envelope which he called the coronal atmosphere.

In 1883, while conducting an eclipse expedition to the Caroline Islands, he proved the reality of the coronal atmosphere by the existence of black Fraunhofer lines in its spectrum.

It was the Franco-Prussian War in 1870 and the Siege of Paris that interrupted the researches of the great astronomer. In the July number of this journal, when speaking of the aeronautical exhibit at the Paris Exhibition, where the historic balloon "La Volta" was on view, the story was told how M. Janssen despised asking permission from the Germans to leave the city to go on a scientific expedition, and independently sailed over the siege-bound walls and Prussian lines in the "La Volta." The expedition in question was that organised to observe the Algerian eclipse, and it may be mentioned that it was the British astronomers who had, through the British Ambassador, obtained the necessary permission of the Germans to allow M. Janssen to leave Paris at the very moment that he showed the freedom of the air by his aerial enterprise. This famous balloon journey took place on December 2nd at six o'clock in the morning, and the descent was made at Savenay, near the mouth of the Loire, after a journey of five hours. The originality of M. Janssen bore fruit during those few hours in the balloon. It was then that he invented the aeronautical compass, by which the position of the balloon can be perpetually indicated on a map.

Digitized by Google

It was in 1874, during the expedition to Japan to observe the transit of Venus, that M. Janssen conceived the revolving photographic camera which automatically secured a successive number of images of a moving object. In this ingenious device was foreshadowed the production of animated photography which has now become so popular as an entertainment.

After M. Janssen returned from this expedition, the French Government realized the necessity of founding an establishment where the discoveries in physical astronomy could be facilitated and fostered. In 1875, the Observatory of Physical Astronomy was erected at Meudon, and its management entrusted to M. Janssen, who had created the need of such an Institution.

It is almost needless to say that, under such a master hand, the Observatory at Meudon has attained a great prominence amongst the observatories of the world. At Meudon there are spacious laboratories for the study of the gaseous vapours of our atmosphere and of those of other planets. In them have been studied the spectrum of oxygen, and the law of the square of its density, which determines the appearance of bands in this gas has been therein discovered.

But the greatest scientific achievement of the Meudon Observatory is the development of solar photography that has taken place within its walls. It is said that its laboratories can boast of the possession of more than four thousand solar photographs.

But the feature of M. Janssen's astronomical work which will specially interest the readers of the "Aeronautical Journal," is his efforts to show that one of the most important uses of the balloon is for astronomical research. When clouds or fogs obscure some long awaited celestial phenomena, such as an eclipse or a meteoric display from observers on the earth, it is then that the aeronautical astronomer can penetrate the intervening veil and gain an unclouded vision of the spectacle. For astronomical purposes, a short vertical journey may save the astronomer miles of ordinary travel in search of a transparent atmosphere. M. Janssen, in stimulating the ambitions of aerial astronomers, whether their task is to observe the Leonides or the complex phenomena of total eclipse, has opened out fields of fresh investigation to the student of the heavens.

M. Janssen is a member of the Institute and the Longitudinal Bureau of the Royal Society of London, the Academies of Rome, Brussels, St. Petersburg, etc. He is Commander of the Legion of Honour, of the Rose of Brazil, of the Scientific Order of Merit of Portugal.

M. Janssen was President of the Academy of Science in 1887 and 1888, and in connection with that establishment founded a prize for physical astronomy. He has also founded prizes in connection with the French Geographical, Photographical and Astronomical Societies, of which he has been, in turn, the President. As has well been said of M. Janssen in the "Collection Encyclopédique des Notabilities du XIX. Siecle," the wish of his life has been to serve science, not only by his researches, his discoveries, and his works, but by his endowments for the encouragement for others to follow his footsteps.

2.—MAJOR F. C. TROLLOPE.

Major F. C. Trollope, late Grenadier Guards, who was chosen by the British Government to be the delegate to represent this country at the Paris Aeronautical Congress, and whose portrait and autograph appears as the frontispiece to our Congress number, is the present distinguished and most resourceful superintendent of the balloon factory at Aldershot.

Major Trollope commenced ballooning with the late Mr. Walter Powell, M.P. for Malmesbury, in 1882, and had a narrow escape from sharing in the fatal balloon disaster which befel that latter gentleman. It was merely the unpunctuality of a train that prevented Major Trollope from ascending with Mr. Powell on the occasion that his balloon was wafted out to sea, and with its passenger lost.

From 1883 onwards, Major Trollope has been associated with Colonel Templer in making military war balloons.

In an article in this journal, January 1900, entitled "The Balloon at the Front," mention was made of the perfection to which the British observation war balloon equipment has been brought, and since the issue of that number, the country has had reason to congratulate itself on the existence of the balloon sections, for the assistance that the balloons rendered at Ladysmith, Spion Kop, and other places, cannot well be over-estimated. Major Trollope and his colleagues should command the warmest congratulations of the public for this excellent result of years of experiment and labour carried on for so long in the face

of prejudice, which the South African campaign will now have for ever dissipated.

In 1884, Colonel Macdonald, D.S.O., of Uquanda fame, with above-mentioned officers, brought out the system of compressing hydrogen in small steel tubes for inflating purposes. Major Trollope and the late Major Elsdale, R.E., took these cylinders filled with gas, in 1884, from Chatham out to South Africa, and made many ascents at Mafeking, in Bechuanaland.

3.—M. WILFRED DE FONVIELLE.

As will be seen in another part of this journal, M. De Fonvielle, the late President of La Societe Francaise de Navigation Aerienne, distinguished as aeronaut and scientist, and whose brilliant and classic balloon voyages have delighted the readers of "Travels in the Air," will come specially from Paris to London in April next, to address the members of the Aeronautical Society of Great Britain. In his writings and discourses, so much vivid colour has M. De Fonvielle given to the adventures and charms of ballooning, that, perhaps, he has done more than any other aeronaut to popularize its pursuit.



M. WILFRED DE FONVIELLE.

During Major Trollope's superintendence of the balloon factory at Aldershot, great activity has been in progress in this department, for not only were balloon sections sent out to the South African Campaign, but the necessities of warfare called for the establishment of repairing and gas factories at the seat of war. Then came the Crisis in China to draw afresh upon the resources of the military balloonists, but this latter, even, did not exhaust them, for Major Trollope has recently despatched a show section to Australia for the show there on January 1st.

As we shall so soon have M. De Fonvielle amongst us, and hear in his own words those details of his life and experiences that he will select to tell us, it is hardly suitable for the writer to forestall his own descriptions, and we will rather await with pleasurable anticipation the dramatic fire and rhetoric skill with which M. De Fonvielle never fails to illumine the theme of the balloon.

Digitized by Google

Perhaps, however, it may be allowable to mention one important feature of M. De Fonvielle's work. He was apparently the first to conceive the great idea of the usefulness of the balloon as an aerial astronomical observatory, the more recent development of which has been already pointed out in the article on M. Janssen.

In "Travels in the Air," page 255, M. De Fonvielle says: "For some time past I had cherished the expectation of observing the interesting phenomenon of falling stars from above the region of the clouds, by means of a balloon. When the aerostat pursues its silent course through the air on a dark November night, it must, indeed, be an interesting moment to the traveller, when hundreds of these small meteors dart across his path—luminous atoms, celestial fires wandering through the immense regions of the atmosphere."

Then he describes how, in November 1867, when he made known his wishes to M. Giffard, that aeronaut generously placed at his disposal, a small balloon, which he endeavoured to fill with pure hydrogen gas, so as to be better suited for the purpose of making journeys long enough to observe the November star showers.

But an imperfection in the apparatus for making the hydrogen caused delay, and M. De Fonvielle mentions how, if it had not been for this unfortunate hitch, he would have risen just as the phenomenon was at its maximum of splendour; as it was, he was obliged to be content with the end of the celestial spectacle.

But a classic writer of old has told us that "the beginning is the half of everything," and though M. De Fonvielle's first astronomical observation was curtailed, yet, undoubtedly to him must be ascribed the inauguration of the Aerial Observatory.



M. LOUIS TRIBOULET.

4.—M. JACQUES FAURE.

M. Jacques Faure, whose picture appears in the group at the heading of the article on

Digitized by Google

the "Vincennes Competitions," is an illustrious member of the Aero-Club, its Treasurer, and an aeronaut whom no difficulty can discourage. To him belongs the distinction of having been the first member of the Aero-Club to cross the Channel in a balloon, and his own account of his journey from the Crystal Palace appeared in the last number of the "Aeronautical Journal."

M. Faure, accompanied by M. Hervé and M. Mallet, came to England quite lately with his balloon "L'Aero-Club," in which he has made so many journeys, with the intention of crossing the North Sea to Holland; but the very tempestuous weather, followed by contrary winds, necessitated a postponement of the attempt. As will be seen in the announcements of the arrangements for the next General Meeting of the Aeronautical Society, M. Faure has kindly promised to come specially from Paris to read before the members a paper on "Nautical Ballooning," and his exposé is awaited with the keenest interest.

5.—M. LOUIS TRIBOULET.

M. Louis Triboulet was the Secretary of the International Aeronautical Congress, and is now Secretary-General of the Permanent Aeronautical Commission. As Secretary of the Congress, its whole organisation fell to him, and to him we may, therefore, attribute much of its success, and all its order and method. The French gift of grasp and manipulation of detail, is possessed in a high degree by M. Triboulet, who may be described as a master of organisation. To him also fell as Secretary of the French Aeronautical Society, the arrangement of the Society's Exhibits in the Paris Exhibition, and there he might be found last spring, day by day, grouping and classifying, but always ready to receive a foreign brother aeronaut, and to turn and lay at his service all the resources of his official position, and all his knowledge of the Exhibition and the City. One of the objects of the Congress was to promote the growth of friendly feeling between the members of all countries attending it, and the selection of M. Triboulet, as Secretary, went far to further this aim. Individuals who have experienced it can testify to the welcoming charm of manner which made every stranger feel a friend, and to the winning sympathy and knowledge so kindly extended.

M. Triboulet, an architect by profession, is an aeronautical photographer of note. He was the first person to take a photograph from a free balloon, on the 9th of June, 1879. He is the ingenious designer of valuable and successful methods of automatic balloon photography.

M. Triboulet helped to found the Academy of Aerostatic Meteorology, and, in addition to being Secretary-General of the Permanent International Aeronautical Commission and Secretary-General of the French Society of Aeronautical Navigation, is also a Vice-President of that Society, and a Vice-President of the Society of Topography of France.

The International Balloon Ascents.

COMMUNICATED BY P. Y. ALEXANDER.

Strassburg Nov. 12th., 1900.

Ascent Nov. 8th, 1900.

TRAPPES near Paris. Unmanned balloon. Ascent 4.18 a.m., 13,000 metres height = H. Min. T.= 53·6° C. Landed in the Department of Nievre, near Entrains by Nohains.

2nd. Unmanned balloon. Ascent, 8.01 a.m. H., 14,200. Min. T.,—50° C. Landed by Méréville (Seine et Oise).

CHALAIS MEUDON. Manned balloon. Le Commandant Paul Renard, le Cne Borschneck et M. Deslandres, landed in Belgium, near Mons, in 6 hours 20 minutes. Besides meteorological observations, M. Deslandres has also made spectroscopic observations.

2nd. Balloon of paper, unmanned, landed near Orleans.

3rd. Manned balloon. Vallot and Comte de la Vaux. Landed near Brussels. H., 4,800 metres. Min. T.—18° C.

STRASSBURG. Balloon of Paper, unmanned ascended 5.22, landed at 12 noon in Kirchworbis, Province of Sachsen, between Thüringen and Harz Wald, in Nordhausen.

2nd. Manned balloon. Lieutenant Witte and Rentner Stollberg. Ascended 8.05 a.m., landed 1.15 p.m., by Frankeneck, near (Neustadt a/H.). Max. H.,—2,100 metres. Min. T.,—1°.

3rd. Silk Balloon, unmanned. Ascended 8.54 a.m., landed at noon N.W. of Geldhausen, in Hessen. Max. H.,—12,000 metres. Min. T.,—54° C.

MUNICH. Registrir balloon, ascended 8 a.m., landed 10.45, near Maierhof Waldheim, Tachau in Böhmen.

VIENNA. Manned balloon. Oberleutnant Tauber and Dr. Valentin. Ascended 8 a.m. Max. H., 5,000 metres. Min. T.,—12°. Distance travelled, 130 Kms. (kilometres) in 4 hours, 45 minutes. Landed Wischau in Möhren.

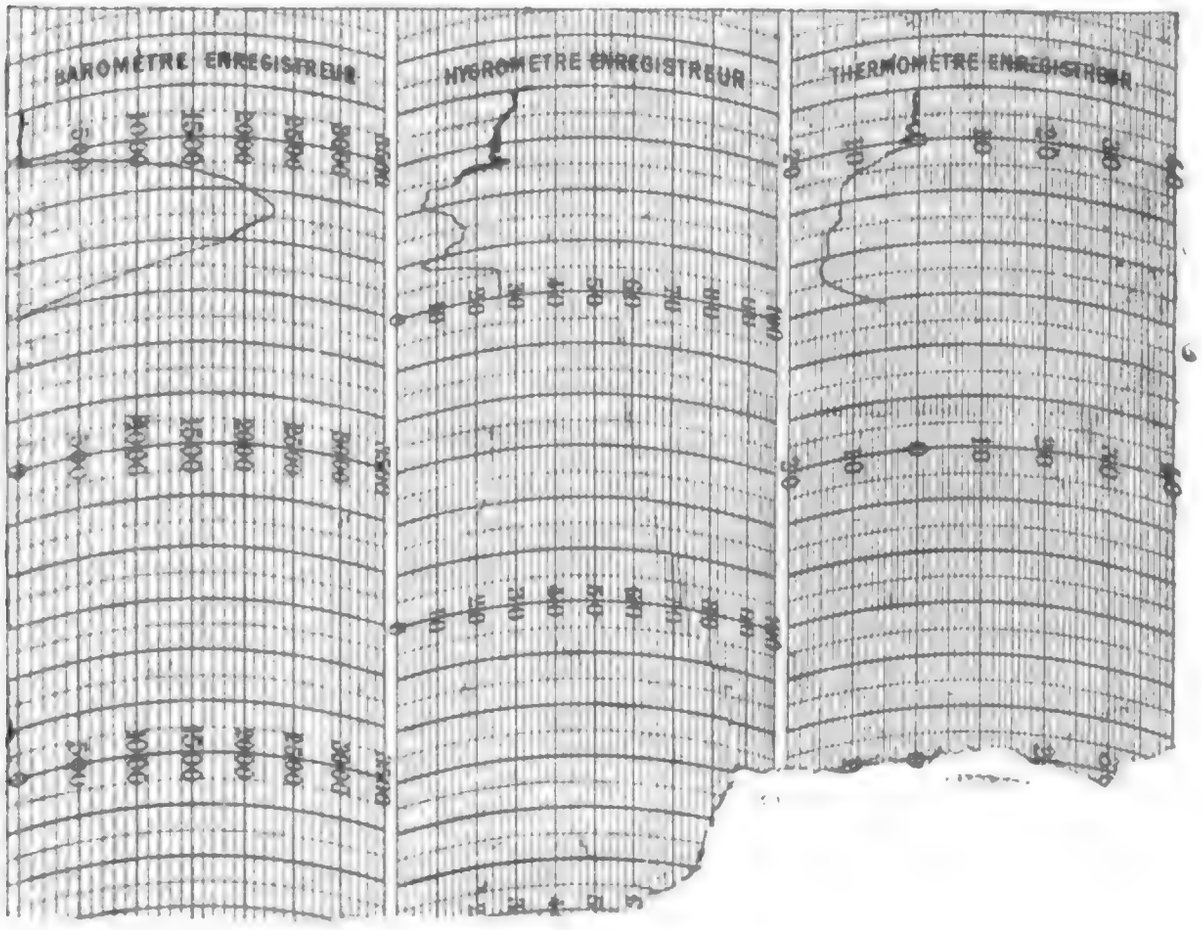
2nd. Manned balloon. His Imperial Highness Archduke Leopold Salvator and Captain Hinterstoissier, ascended at 8. 3,800 metres. Min. T.,—7, 6°. Duration, 5 hours, 30 minutes. 150 Kms. Landed in Temnitz, in Möhren.

BATH. Unmanned balloon. Ascended at noon. Landed at Cricklade, between Cirencester and Swindon, at 12.45. Max. H., 2,300 metres.

2nd. Manned balloon. Spencer, Bacon, and Pierce. Ascended from Crystal Palace. Max. H., 1,500 metres. Min. T.,—0°. Descended Halstead, Essex, in 40 minutes.

BERLIN. Unmanned balloon. Ascended 4.45 a.m. Landed at 7 a.m., Ramin, in Pommern, Kreis Randow, 120 Km. N., 35° E of Berlin. Average speed, 9 metres per second. Max. H., 8,005 metres. Min. T.,—36°.

RECORD OF THE FIRST BRITISH BALLON SONDE.



2nd. Manned balloon. Ascended 7.30 a.m. Dr. Berson and Knopp. Landed 4.16 in Hinterpommern. Duration, 8 hours 46 minutes. Distance travelled, 330 Kms. Max. H., 5,900 metres. Min. T.,—21°.

ST. PETERSBURG. Unmanned balloon. Ascended at 8 a.m.

2nd. Manned balloon. Ascended 9 a.m. Max. H., 3,700 metres. Min. T.,—8°. Landed 190 Kms. N.E. direction. Temperature on ground, + 1°; 700 metres high, — 3°; and 1,300 metres high, + 4°!!

Digitized by Google

NOTES.

The French Kite which fell in England.—In the July number of this journal, there was a note of a descent of a French kite at Burmash, in Kent. M. Delcourt, the owner of the kite, has written to Mr. Salmon a very interesting letter on the subject, and through Mr. Salmon's courtesy in forwarding this letter to the editor of this journal, it is possible to mention the following details. M. Delcourt ascribes the falling of the kite in England to a sudden increase in the wind force. The cord used, he had tried a few days before with a strain of 35 kilos. On the day it broke, the strain could not have been more than 20 kilos, but any rubbing of the cord at the moment of launching the kite can weaken it at that point, and that was what had probably happened. He thinks that without the cord forming a guide rope attached to it the kite, instead of being carried by a sudden acceleration of wind to fall in England, would have fallen in the sea about three miles only from France. This French experimenter dwells on the difficulty of attaching the cord satisfactorily, and advocates an arrangement that will give greater play to the kite.

Andree's Message.—The "Morning Leader" recently published an interesting facsimile in the original language of Andree's first and last message contained in the buoy picked up in the Arctic Zone on August 31st, and now deposited in the museum at Stockholm. The message was as follows:—"Buoy No. 4.—The first to be thrown out, 11 July, 10 p.m. Greenwich mean time."

"All well up to now. We are pursuing our course at an altitude of about 250 metres. Direction at first northerly, 10 degrees E.; later, northerly, 45 degrees E. Four carrier pigeons were despatched at 5.40 p.m. They flew westwards. We are now above the ice, which is very cut up in all directions. Weather splendid. In excellent spirits.

"Andree, Strindberg, Frankel.

"[Postscript] later on; above the clouds, 7.45 Greenwich mean time."

As this message is stated to be the first despatched, it is with some reason that the other empty buoys that have been found are supposed to be the testimonies of a disastrous issue to the boldest balloon voyage ever undertaken by man.

The Great Berlin Balloon.—In the July number of this journal, attention was drawn to the preparations in progress in Berlin, for the construction and equipment of a large balloon for a scientific expedition, the principal object of which was to determine the duration of the lifting power of balloons. In the October issue a telegram from Mr. Alexander was published, announcing the departure of the balloon from Friedman on September 24th at 5.53 p.m.

The passengers in the balloon were Dr. Berson and Dr. Suring of the Meteorological Institute, Herr Zekely of Potsdam, and Mr. Alexander, a member of the Aeronautical Society of Great Britain. The car had been provisioned for a six weeks' journey, but the expedition came to an abrupt conclusion during the night after the start, as the drag rope caught in the trees of the forest near Bernau, and the scientists were forced to descend.

The History of the War Balloon.—A contributor to the German "Militai-Wochenblatt," has collected some valuable information concerning the history of the war balloon, which, from its success in South Africa, is now engaging the increased attention of all nationalities. As far back as 1784, General Meusnier appears to have sent up a captive balloon to observe the movements of the enemy. Ten years later, at the siege of Conde, General Chancel wished to employ this means of getting information, but failed to do so, owing to the loss of gas by his balloon, which fell into the hands of the enemy. In 1794, the central balloon school was established at Meudon, under the guidance of Conte and a balloon company was formed, which was employed at the Siege of Maubenge, daily ascents in a captive balloon being made for purposes of observation. This balloon was again used at the Siege of

Digitized by Google

Charleroi, the battle of Fleurus, and in reconnaissances at Worms, Mannheim, Aix, and Wurzburg, on the surrender of which latter town it fell into the hands of the besiegers. Napoleon, however, disbanded the two balloon companies which had been formed, closed the school at Meudon, and sold the material on hand. Carnot used a captive balloon at the Siege of Antwerp in 1814, and another was used in 1859 on the eve of Solferino. In the Civil War in America, a regular balloon service was organised, as also in 1866, in the war between Paraguay and Brazil. During the Siege of Paris in 1870-7, the use of free balloons was strikingly and usefully demonstrated in enabling 91 persons and 10,000 kilos of letters to be conveyed out of the besieged city. Since that date military balloon establishments have been founded in every European army, and also in America, and it is pointed out that in the development of war balloons, England has certainly led the way.

Balloons were used by the French in the Tonkin Expedition of 1882, and at Bac-Ninh and Hoang-ho in 1884. In the Madagascar Expedition in 1895, a balloon party was taken out, though no actual use appears to have been made of the balloons in that campaign. It is stated that in Germany, in the establishment of a modern military balloon department, many obstacles had to be surmounted, and many prejudices to be fought, before, in June, 1884, an experimental captive balloon station could be created by the Ministry of War, and, even after this, two years elapsed before a regular balloon detachment was formed, attached to the railway regiment, and placed at the disposition of the general staff. Only in 1887 was a special uniform allotted to the military balloonists. The writer of the article thinks that the present German captive military balloon is unquestionably the best extant, and claims that it is capable of ascending to great heights, and possesses great stability even in windy weather.

The Italian Experiments in Firing on War Balloons.—The Italian Government have recently conducted some experiments at the camp of San Maurizio, to ascertain the effect of fire on balloons, the trials being made under Colonel Danione. Fortress guns of various calibre were used. In the first experiment, 9-cm guns were used, which were fired at a captive balloon at a distance of about three kilometres, and at an elevation of 300 metres. One sharpnell sufficed to bring the balloon down. In the second experiment bronze position guns of 12-cm. calibre were used, the distance being five kilometres, and the balloon 500 metres high. Six or seven shots severed the cable holding the captive balloon, which broke loose. In the third experiment, 15-cm. guns were used, and an identical result obtained.

The experimenters have concluded that it could be made practically impossible for an enemy to make observations of the interior of a fortified position. It has, however, been pointed out that, though it may be easy to hit a stationary balloon, it becomes a very difficult matter when motion is imparted to the balloon. The danger would, therefore, be in still weather, and in such meteorological conditions when motion is not given to the balloon by the wind, it becomes expedient to impart movements to the balloon. Experience has, however, shown that a moving free balloon is difficult to hit. In the case of the free balloons that escaped during the Siege of Paris, the Germans manufactured special "balloon guns," which could be fired at a very high angle of elevation, and with which they hoped to destroy many of the balloons, but the missives never once hit the aerial targets.

The Value of Pure Oxygen in High Balloon Ascents.—The advantage of inhaling pure oxygen in high balloon ascents was fully realised by M. Jaques Balsan and M. Godard in their high ascent in connection with the Paris Exhibition competitions. At about 18,000 feet, the aeronauts both began to feel disagreeable sensations, their temples ached, their faces grew pale, and objects were blurred before their eyes. At 20,150 feet, M. Jacques Balsan was practically prostrated, and could not speak or get to his bag of vivifying oxygen. M. Godard handed the bag to him,

Digitized by Google

and in a minute he was completely recovered. Pursuing their upward course, M. Godard, in his turn succumbed, and was apparently paralysed. He, too, revived when he imbibed the oxygen. By both keeping the oxygen tubes in their mouth, the intense sufferings of breathing the upper atmosphere was avoided. The diary of the aeronauts runs as follows:—"20,950 feet, we feel better, thanks to the oxygen tubes we keep in our mouths. 21,450 feet, the cold is intense, our beards are covered with ice. 22,400 feet, we are both in pain and unable to speak a word." This was, however, their limit of endurance. It is stated that at that height, it required their united efforts to enable one of them to step on to a bag of ballast. It is hardly surprising, therefore, that the aeronauts decided to descend. It is, however, stated that Comte de la Vaulx claims that he ascended in his balloon to an altitude of 24,000 feet.

London Institution Lectures.—The annual winter series of lectures at the London Institution includes a lecture by Mr. Eric Stuart Bruce, on "Modern Aeronautics" illustrated by lantern views, working models, and experiments. This lecture will be delivered in the theatre of the Institution, on Thursday, January 17th at 6 p.m.

Royal Institution Friday Evening Discourses.—On February 8th, the Royal Institution will again devote a Friday evening discourse tg the subject of The Subjugation of the Air, when Professor G. H. Bryan S.C.D., F.R.S., will lecture on the "History and Progress of Aerial Locomotion."

Publications Received.

"Vertical Gradients of Temperature, Humidity, and Wind Direction." A preliminary report on the kite observations of 1898. Department of Agriculture, Weather Bureau, Washington, United States, America.

"Sounding the Ocean of Air," by A. Lawrence Rotch, S.B., A.M. Society for Promoting Christian Knowledge, London.

"By Land and Sky," by the Rev. John M. Bacon, M.A., F.R.A.S. Isbister and Co., Tavistock Street, London.

These three works will be fully reviewed in the next number of this journal.

Owing to pressure on space the accounts of the latest experiments with the Zeppelin Airship, the lists of Foreign Periodicals, and Notable Articles will be reserved for the next number.

Applications for Patents.

(*From October 1st, 1900.*)

The following List of Applications for Patents connected with Aeronautics has been specially compiled for the *Aeronautical Journal* by Messrs. Bromhead & Co., Patent Agents, 33, Cannon Street, London, E.C.:—

17,367 of 1900. Louis Gathman. Improvements Relating to Flying Machines.

17,371 of 1900. Emil Lehmann. Improvements in and Relating to Flying Apparatus.

18,487 of 1900. George Howard Wright. Improvements in or Relating to the Moving of Balloons, Flying Machines, and the like.

17,961 of 1900. Edward Anderson. Improvements in Balloons and Flying Machines.

18,287 of 1900. Andrés Vegara. A New or Improved Flying Machine.

18,837 of 1900. Josef Birk. Improvements in or Relating to Balloons.

18,954 of 1900. ELEANOR, MARIA, LANSDOWN CASE, and FRANK JAMES GRAY. **Apparatus for Giving Warning of an Alteration in the Steering of a Vessel, Balloon, or like.**

19,424 of 1900. JEAN TARBE. **Improvements in Aeroplanes.**

20,336 of 1900. ALBERT TIETZ. **Aerostatic Improvements.**

20,952 of 1900. EDWARD EUGENE DULIER. **An Aerial Soaring and Travelling Apparatus.**

21,947 of 1900. CASSIUS MONTEZUMA, Richmond. **Improvements in Airships.**

22,046 of 1900. IZMAY MASSEY. **Aerial Signalling and Aerial Advertisements.**

22,120 of 1900. ANDRÉS VEGARA. **Improvements in Wings of Flying Machines and like.**

22,444 of 1900. GEO GRANT. **Improvements in Means for Steering Aerial Yacht.**

Digitized by Google

620.5
A2 45

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH.
AUG 4 1901

THE AERONAUTICAL JOURNAL



Edited for the Council of the Aeronautical Society of Great Britain

By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 18. APRIL, 1901. VOL. V.

All Rights Reserved]

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	21
THE ADDRESS OF CONDOLENCE TO THE KING, AND HIS MAJESTY'S REPLY	21
THE FORTHCOMING GENERAL MEETING	22
IN MEMORIAM	23
SOME CELEBRITIES OF THE PARIS CONGRESS— No. 6. MR. A. LAWRENCE ROTCH. (*Portrait*)	24-25
THE EXPERIMENTS WITH THE ZEPPELIN AIRSHIP. BY A MEMBER OF THE PARIS AERO-CLUB	25-27
THE KRESS DRAGON FLYER	27
REVIEWS—1. "VERTICAL GRADIENTS OF TEMPERATURE, HUMIDITY, AND WIND DIRECTION." BY DR. H. C. FRANKENFIELD	27-29
2. "SOUNDING THE OCEAN OF AIR." BY A. LAWRENCE ROTCH	29-31
3. "BY LAND AND SKY." BY THE REV. JOHN M. BACON	31-32
MEETINGS OF THE PERMANENT INTERNATIONAL AERONAUTICAL COMMISSION	32
THE INTERNATIONAL BALLOON ASCENTS, DECEMBER 6TH, 1900. COMMUNICATED BY PATRICK Y. ALEXANDER	33
NOTES—THE EFFECTS OF VERTICAL AERIAL CURRENTS ON BALLOONS—THE PROJECTED BALLOON TRIP ACROSS THE MEDITERRANEAN—AERONAUTICAL EXHIBITS AT THE ROYAL INSTITUTION SOARING MACHINES—THE RETURN JOURNEYS OF THE NAVIGABLE BALLOON, "LA FRANCE"—KITE-FLYING RECORDS	33-35
OBITUARY—PROFESSOR G. F. FITZGERALD	35
FOREIGN AERONAUTICAL PERIODICALS	35
NOTABLE ARTICLES	35-36
APPLICATIONS FOR PATENTS	36

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., GOUGH SQUARE AND BOLT COURT, E.C.

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL:—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G. F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901,

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portra
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

Digitized by Google

THE AERONAUTICAL JOURNAL.

APRIL, 1901.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road, Kensington, London, W.

NOTICES OF The Aeronautical Society.

A special meeting of the Council was held at the Society of Arts on Thursday, January 31st, 1901.

RESOLVED—

That the following address of condolence on the occasion of the lamented death of Her Late Majesty Queen Victoria should be presented to His Majesty the King :—

"To His Majesty King Edward VII. of "the United Kingdom of Great Britain and "Ireland, Emperor of India.

"We the undersigned members of the "Council of the Aeronautical Society of "Great Britain on behalf of the Council "and Members of the Aeronautical Society "of Great Britain, wish to humbly offer our "condolences to your Majesty on the great "sorrow you have sustained in the death of "our beloved Sovereign, the late Queen, "and to present our congratulations to your "Majesty on your accession to the Throne "and to respectfully assure you of our un-"swerving loyalty and devotion to your "Majesty's person."

Signed, EDWARD P. FROST, *Chairman.*
EDWARD A. BARRY.
WILLIAM CROOKES.
LESLIE M. EARLE.
JOHN DAVIDSON FULLERTON.
HIRAM S. MAXIM.
H. C. ROBERTS.
ERIC STUART BRUCE,
Honorary Secretary.

The following reply of His Majesty has been received through the Home Secretary by the Honorary Secretary :—

HOME OFFICE,
WHITEHALL,
15 *February*, 1901.

SIR,—I am commanded by the King to convey to you hereby His Majesty's thanks for the loyal and dutiful address of the Council of the Aeronautical Society of Great Britain, expressing their sympathy with His Majesty and the Royal Family on the occasion of the lamented death of Her Late Majesty Queen Victoria.

I am, Sir,
Your obedient Servant,
(Signed) CHAS. T. RITCHIE.

The following gentlemen have been elected Members of the Society :—

PROFESSOR GEORGE HARTLEY BRYAN, SC.D., F.R.S.

MR. SAMUEL HERBERT RIDER SALMON.

The following gentlemen have been elected Honorary Members of the Society:—

Monsieur Wilfred de Fonvielle, Ex-President of La Société Française de Navigation Aérienne, on account of his distinguished services to Aeronautical Science.

Monsieur Jacques Faure, the Treasurer of the Paris Aéro-Club, on account of his eminent work in Practical Ballooning.

GENERAL MEETING.

The next General Meeting of the Aeronautical Society will be held in the Rooms of the Society of Arts, John Street, Adelphi, on Monday, April 15th, at 8 p.m. Major H. C. Roberts will take the chair.

For this occasion Monsieur Wilfred de Fonvielle, Ex-Annual President of La Société Française de Navigation Aérienne, will come especially from Paris to London to address the Members of the Aeronautical Society of Great Britain (in English) on "Aeronautics in France," when he will describe the progress made since he escaped in a balloon during the siege of Paris, in November, 1870, and discuss the actual prospects of Aerial Navigation.

The discourse will be illustrated by lantern slides.

Mr. Charles Groombridge (Member of the Aeronautical Society) will exhibit and explain his new Propeller for Aeronautical purposes.

There will be a demonstration of the "Meteoparachute," a new instrument for investigating the upper atmosphere, by Mr. Eric Stuart Bruce, M.A. Oxon., F.R.Met.Soc.

During the evening a series of lantern slides in illustration of the trial trips of the Zeppelin Airship and M. Santos Dumont's Navigable Balloon will be projected on the screen.

A working model of a Navigable Balloon will also be exhibited in action.

Members are reminded that they have the privilege of introducing two friends to the General Meetings of the Society.

Members and Correspondents of the Aeronautical Society are reminded that the present address of the Aeronautical Society is 19, Campden House Road, Kensington, London, W., and that all communications should be addressed to the Honorary Secretary to that address.

ANNUAL SUBSCRIPTIONS.

The annual subscriptions to the Aeronautical Society are now due. Those Members who have not yet paid their annual subscriptions are requested to forward them to the Honorary Secretary, 19, Campden House Road, Kensington, London, W. The attention of those Members is called to Rule IVa, which states that the privileges of Members extend only to those who have paid their subscriptions for the current year.

ERIC STUART BRUCE,
Honorary Secretary.

Digitized by Google

In Memoriam.

SINCE the last issue of this journal all its readers have been united in one common tie—the tie of sorrow for the loss of our beloved and honoured Queen, and the sounds of public and private joy have been hushed awhile in the tremendous gloom which so suddenly enshrouded our nation. Few of us had not felt the shadow of death in its intensity, but we then saw it in its immensity. From its presence there could be no escape. It overhung the length and breadth of the land; nor indeed were its limits defined by those boundaries which men mark out under the name of nationalities, for those whose duty called them from these shores on the days of sorrow when they landed on some foreign soil emerged not from the canopy of gloom. E'en where the revered lady held no regal sway she had become monarch of men's hearts.

Of the Victorian Era and the great personage whose influence went far to make it one of the most extraordinary epochs in the world's history, many pages have been already written. It is meet that a scientific journal should select some point of view which has a marked bearing on the progress of science generally, and of the particular science of which it is the organ.

That the Victorian Age has been one of extraordinary scientific development is apparent to everyone in the rapid strides which the applications of science have taken, even in the memories of those who may still be called young, while those who can remember the accession of the late Queen in 1837 will indeed bear witness to the contrasts in the mode of life between that year and the opening of the new century. When we proudly celebrated the Jubilee of Queen Victoria in 1887 we were struck by the fact that the Jubilees of nearly all the foremost applications of science were coincident with Her Jubilee. In 1889 we kept the Jubilee of the Electric Telegraph. In the following year we commemorated the Jubilee of the first passage of an Atlantic steamer from the Old World to the New. 1889 brought into Jubilee celebrations that of Photography, which was first developed in 1839; that of the Screw Propeller, and that of Nasmyth's Steam Hammer. We had indeed a galaxy of invention to grace the commencement of a brilliant reign, and a host of prospering scientific Jubilees to enhance the beneficent fame of the year 1887. It is natural to look for causes to account for the prospering developments of these various inventions, all of which may be said to share in the civilizing tendency of abridging distance and shortening time. Many causes must have united to bring about so prosperous an issue, but one cause stands out prominently in relief. This cause, indirectly, we owe to our Queen. It was the genius, energy, and individuality of the late Prince Consort which first made practical science international. He planned and carried out the great International Exhibition of 1851, which first gave our nation the opportunity of comparing the wealth of the world and made her own industry known and sought after in every clime.

It may be thought by some that Aeronautics has not equally shared in the progress of the Victorian Era, since the great problem of air navigation has yet to be solved.

But this indeed is a fallacy. The balloon, by its power of overcoming gravity, has added vastly to our means of acquiring knowledge of the upper atmosphere, and most of the great truths learnt by its means will be found to grace the Victorian Era. The bond of Cosmopolitanism has ever been peculiarly strong betwixt the aeronauts of every nation, and it is largely through international work and co-operation that aeronautics is rapidly assuming so dignified and important a position. Many are the branches of usefulness opening out for its enterprise. It is on the advance of this science that the future advances of meteorology must depend, and the two sciences are destined to act and re-act on one another for their mutual advantage. The war in South Africa has shown the value of the balloon in warfare, and our national balloon equipments alone tell of modern progress in balloon manufacture and balloon accessories. There is, too, a consoling thought concerning the experiences of the balloon in the South African struggles. Its presence in the campaign most certainly hastened victory, and averted one terrible disaster, so that the balloon actually lessened by at least one the sorrows and griefs which our Queen endured, on account of this campaign, during the last year of her life.

Some Celebrities of the Paris Congress.

No. 6.—MR. ABBOTT LAWRENCE ROTCH.

From time to time we have had occasion to mention in this journal the kite work of Mr. Rotch at the Blue Hill Observatory, and it is, therefore, with great pleasure, that we are able to present to our readers a portrait of this eminent meteorologist, and a sketch of his career. It will be seen that Mr. Rotch



MR. ABBOTT LAWRENCE ROTCH.

not only founded the Blue Hill Observatory, but he directs its work, and with unstinted generosity, maintains it. Considering the extreme importance to meteorology of his great heights in the free air by means of kites, Mr. Rotch may be considered one of the greatest benefactors to meteorological science.

Mr. Abbott Lawrence Rotch was born in Boston, U.S.A., in 1861, and studied mechanical engineering at the Massachusetts Institute of Technology. Being interested in meteorology and possessed of an independent fortune, he established, in 1885, a meteorological observatory on the summit of Blue Hill, the highest land in the vicinity of Boston. This observatory has since been supported and directed by him; there are three assistants, and the annual cost of maintenance exceeds £800. The investigations and observations are published in the *Annals of the Astronomical Observatory of Harvard College*. These relate especially to cloud measurements and the results obtained with kites. Mr. Rotch has travelled extensively in Europe and America. In 1885 and in 1887 he studied the mountain observatories and the meteorological services of Europe, and published an account of them in the *American Meteorological Journal*, of which he was associate editor. He observed the total solar eclipses of 1887, 1889, 1893 and 1900, in order to make certain meteorological observations. At the Paris Exposition of 1889, Mr. Rotch was the American member of the International Jury of Awards for scientific instruments, and received himself the Cross of the Legion of Honour. In 1891 he attended the International Meteorological Conference at Munich, and was there appointed a member of the International Committee on Clouds, which

Digitized by Google

has done an important work in issuing an atlas of cloud forms and in instituting measurements of their height and velocity all over the world. Mr. Rotch, having made several balloon ascents, was interested in scientific aeronautics, and, accordingly, in 1894, furnished the opportunity to Mr. W. A. Eddy to raise a self-recording instrument with his kites from the Blue Hill Observatory. The practicability, thus demonstrated, of obtaining simultaneous observations on the ground, and in the free air with kites, led to the prosecution of the exploration of the air at various heights and under different weather conditions, with increasing energy, so that, at the present time, it is the chief work of this observatory. In 1896 Mr. Rotch presented his method of investigation to the International Meteorological Conference at Paris. He was chosen a member of the International Aeronautical Committee, which met again at Strassburg in 1898, and has conducted the systematic exploration of the atmosphere with balloons and kites on the continent of Europe. As the work at Blue Hill became known, it was repeated elsewhere, notably by the United States Weather Bureau which, in 1898, attempted to obtain from 16 stations situated in the central States, daily observations at the height of a mile for forecasting. Unfortunately, this scheme was frustrated in many instances by light winds. At Trappes, near Paris, M. Teisserenc de Bort, using Mr. Rotch's kites, began a systematic study of the upper air in connection with "ballons-sondes" for greater heights. Last year the Prussian Meteorological Institute established, near Berlin, a special Aeronautical Observatory for the prosecution of similar researches, and investigations with kites are also being carried on at Hamburg and at St. Petersburg. The extreme heights reached with kites, both at Trappes and at Blue Hill, exceed three miles, and the meteorological results are proving of the greatest importance for the progress of the science.

Mr. Rotch is a corresponding member of the British Association for the Advancement of Science, the German Meteorological Society, and the German Society for the Promotion of Aeronautics. He is also an honorary member of the French Alpine Club.

Members of the Aeronautical Society of Great Britain will be interested to hear that Mr. Rotch is preparing, for a future meeting of that Society, a paper on the principal scientific discoveries that have been made by means of kites.

Experiments with the Zeppelin Airship.

In the October number of this journal some account was given of the first ascent of the Zeppelin Airship on July 2nd. Great efforts were made to renew the experiments in the autumn months, during which calm weather so frequently prevails, for, undoubtedly, this is at present, an essential condition for any airship that is navigated by mechanical means. At first it appeared as if these efforts would be frustrated, as an accident happened to the great balloon in its shed on the night of September 24th, which retarded the experiments for several days. In the middle of the night the aluminium frame which was suspended to the roof of the floating house suddenly fell down, and the central portion of it was bent and damaged in several places. The damage, however, was repaired by October 17th, and after waiting for a storm to subside, the balloon was filled for an ascent on October 24th. The inflation of the 17 balloons with pure hydrogen was accomplished with great dexterity and speed, and the signal for the ascent was given at 4.45 p.m. It appears that almost absolute air stagnation prevailed at the time of the ascent, which took place in rainfall and under a completely overcast sky. There seemed every chance that the great airship would distinguish itself by making a long journey. The stillness of the air was not only confined to the atmosphere bordering upon the surface of the earth, but the same condition was apparent at some little altitude. A small military unmanned captive kite-balloon took an absolutely vertical position. The balloon carried an anemometer whose indications were registered on the ground by means of a connecting cable. A pilot balloon that was sent up also testified to the quietness of the atmosphere, as, after it had ascended to several hundred metres, it fell only twenty metres distant from the place where it had been sent up. The passengers in the airship on this occasion were Count Zeppelin, M. Burr, M. de Krogh, M. Wolf, and M. Gross. The ascensional force was 70 kilos., and the ballast carried was 1,200 kilos. The aerostat was in equilibrium at the height of 300 metres above the lake.

Captain H. W. L. Moedebeck has pointed out in an article in "Illustrirte Aeronautische Mitheilungen" (October 1900), that no accurate estimate of the speed of airships can be obtained by short journeys; and this might have been an opportunity of deter-

mining accurately the absolute and relative speed, by taking a fairly long excursion in the direction of the aerial current; but an accident was unfortunately forthcoming to hinder the execution of any such useful programme. One of the rudders at the back of the vessel which had been placed too near the exterior of the envelope of the balloon caught in it and remained fixed on the larboard, so that the balloon turned to larboard. It was a little while before the aeronauts found out the cause of this movement, and there was consequently a delay in getting the others to act in opposition. As the balloon had descended to a low position and it was getting late, it was decided to turn the balloon to the left and go backwards, so as to alight on the floating bridge. But the first time this manœuvre was attempted the ship was turned too suddenly and it got out of a favourable position for the descent. A second attempt was more successful, and the balloon was just in the right position to descend on the bridge by taking an inclined curve, when another accident happened which forced a more rapid descent on to the lake. This was the collapse of one of the seventeen balloons, the gas suddenly escaping owing to the valve having automatically opened. This loss of gas so diminished the buoyancy of the balloon that it was impossible to maintain it any longer in the air. The aluminium cars floated on the surface of the lake, and the airship was towed to its resting place. The length of this ascent was one hour and twenty minutes; but it cannot be called a journey.

Another trial took place on October 21st at 4.55 p m., and in another calm atmosphere. This time the balloon was only in the air twenty minutes, but the ascent was, perhaps, the most successful of the series. The balloon made an actual return journey, travelling part of the time against the feeble current, and the descent was manœuvred quite close to the shed. For this ascent two of the rudders were dispensed with, one in front and one behind being retained. By this arrangement it appears that the balloon was very manageable, and answered perfectly the movements of the rudders. There was, however, a disadvantageous circumstance during this ascent, which was, the want of pure hydrogen obtained by electrolysis, to fill the balloon which had been accidently emptied during the previous ascent. The gas used was too heavy, and it was the want of lifting power that curtailed this last ascent.

The speed of the balloon is estimated at 3 m. 5. per second when going against a wind of 3 metres per second; but as has been above stated, it is not fair to judge of exact speeds from ascents in which only short journeys are made. It is to be hoped that longer journeys will be made during the coming summer if the winds and storms of the winter which have played such havoc with the airship have not put fresh experiment out of the range of practicability. It seems, indeed, strange and improvident that after a fortune had been spent in building this unique machine it should be left to the mercy of the tempest when means of protection might have been afforded at trifling cost.

If further experiments are made with the great balloon next summer, and if anything like a long journey is attempted it is hoped that exact measurements of the wind force will be taken from the cars of the ship itself, and not only by occasional test balloons and from the platform of the balloon shed. The wind force on the platform of the boat-house might not represent at all the forces at 300 feet elevation. Experiments at the summit of the Eiffel Tower have proved that the average velocity of wind at even that moderate elevation during the summer months to be much greater than has been supposed. It is found that the average of 100 days of observation from the summit of the Eiffel Tower is rather more than 7 metres per second, the average on the ground being rather more than 2 metres per second. It would seem, therefore, that for most days of the year the wind velocity taken at the platform of the balloon shed would be useless for the question at issue, viz., the wind force actually encountered by the balloon. However, the days on which the experiments with the Zeppelin Airship were made appear to have been exceptionally still, and, possibly, the platform records fairly represented the wind force at the higher levels in which the balloon travelled. Therefore, the wind forces taken on the roof of the balloon shed every three minutes during the first flight of the balloon on July 2nd, are here appended:—

Time.	Wind force in metres per second.
8. 0 p.m.	5.5
8. 3 ,,	5.3
8. 6 ,,	2.6
8. 9 ,,	4.4
8.12 ,,	2.7
8.15 ,,	4.3
8.18 ,,	3.8
8.21 ,,	3.7

One of the main points on which Count Zeppelin is to be congratulated is that three

Digitized by Google

times he has raised petroleum motors of considerable power in a balloon without a conflagration. This is, in itself, a remarkable feat. But could he have done this had there been any wind worthy of the name on the days of experiments?

There can be no doubt that Count Zeppelin, by the construction of the airship, has stimulated aeronautical enterprise in all parts of the world; and everyone will admit that he has well earned the honour of the Order of the Red Eagle which the German Emperor has bestowed on him.

The Kress Dragon Flyer.

There can be no doubt that the development of the autocar has done very much to stimulate fresh efforts to solve the problem of air navigation by means of a body heavier than air, for it first concentrated attention on those light and powerful benzine motors which the air student is pressing into the service of aeronautics. One of the latest efforts attracting public attention in Germany is the Kress Dragon Flyer—a flying machine constructed on the aeroplane principle. But though Herr Kress has been stimulated to new efforts by the possibilities of modern light motors, he has been working at his invention since 1878. Lately he has received substantial encouragement by the German Emperor's gift of £208, which may not only be in itself an aid to the construction of the light motors he considers necessary to success, but may also be an attraction to the generosity of others.

The Kress Aeroplane may be described as an iceboat having two keels and a long stem. These keels act as runners when the machine is travelling over ice or snow. The boat will also glide on the surface of water. Two resilient sail propellers rotated by a benzine motor in opposite directions provide the motive power. There is not a single aeroplane in this machine, but three arched sails or kites are carried, one sail or kite being mounted somewhat above the other so that it will receive an impinging body of air without interference from the other sails. There is an horizontal and vertical rudder for guiding the aeroplane. Want of funds has hitherto prevented the inventor from making a light motor of the design planned, and, therefore, he has not yet attempted to rise in the air, but has been contented with excursions on the water, which he first made in 1900, having borrowed a two-cylinder motor for these aquatic trials. Herr Kress considers that experiments on the water are necessary preliminaries to the more daring departure of aerial flight. A recent article in the *Scientific American* points out that these excursions give the inventor the opportunity of ascertaining whether all the parts of the machine work properly, enabling him to practise, gradually increase the speeds, and imparting a sense of security which may at last give him sufficient confidence to rise in the air. Herr Kress thinks that the moment of rising may come unawares. The ship may, of its own accord, leave the water. According to calculations made by Lilienthal, it is considered that to leave the land, the speed necessary for the machine to lift itself should be at least 9 metres per second; when travelling in water, Herr Kress calculates it would have to be 10 metres per second; but when once lifted into the air, the speed would be changed to 16 metres per second.

REVIEWS.

VERTICAL GRADIENTS OF TEMPERATURE, HUMIDITY, AND WIND DIRECTION: A Preliminary Report on the Kite Observations of 1898. By Dr. H. C. Frankenfield.

We have recently received from the United States Department of Agriculture Weather Bureau, Dr. H. C. Frankenfield's preliminary report on the United States Weather Bureau Kite Observations of 1898, which is a most valuable contribution to meteorological knowledge, and goes far to prove the usefulness of the kite as a means of taking systematic observations of various conditions of atmosphere, though there is a limit to the usefulness of the kite owing to the break in the observations which must occur on account of the number of days in the year when there is not sufficient wind to fly the kite. This disadvantage would appear to point out the desirability of calling in the use of captive balloons for those days when there is not sufficient wind to raise the kite. By the use of both these agents for raising self-recording instruments, the wind force determining which should be used, there need not be interruption in the observations. But even though weather conditions broke the continuity of these ascents, the *Meteorological Journal* of July, 1900, considers that Dr. H. C. Frankenfield's paper "discusses probably the largest amount of free air meteorological observations ever taken within a like space of time over so large an area, and adds to the general knowledge of temperature and

Digitized by Google

hygrometric condition of the lower levels of the air."

The kite ascents were commenced at seventeen stations during the latter portion of the month of April, and were continued into the early days of November, 1898; but in the report only the results of ascents from May to October have been tabulated. The seventeen stations were as follows:—Washington, D.C.; Cairo, Ill.; Cincinnati, Ohio; Fort Smith, Ark.; Knoxville, Tenn.; Memphis, Tenn.; Springfield, Ill.; Cleveland, Ohio; Duluth, Minn.; Lansing, Mich.; Sault Ste. Marie, Mich.; Dodge City, Kans.; Dubuque, Iowa; North Platte, Nebr.; Omaha, Nebr.; Pierre, S. Dak.; Topeka, Kans.

The highest of these stations was North Platte, Nebr., which was 28,111 feet. The lowest was Washington, D.C., which was only 115.

There were made 44 per cent. of the total number of ascensions which would have been possible had the wind and weather conditions been favourable. The percentage of ascents at the different stations varied from 75 at Dodge City, Kans., where the wind velocity was greatest, to 12 at Knoxville, Tenn., where it was least. The largest number of ascents was obtained in the country west of the Mississippi River, and the least in the central river valleys.

The temperature conditions at all elevations and under varying conditions of weather and time have been computed in terms of the gradient in degrees Fahrenheit for each 1,000 feet, and in the increase of elevation necessary to cause a fall of 1 degree in the temperature. The mean results, however, are given only in degrees per 1,000 feet.

Attention has also been given to the questions of wind directions, relative humidity, and vapour pressure.

The following concise summary of the observation is given in the introductory chapter.

I. TEMPERATURE.

"The mean rate of diminution of temperature with increase of altitude, as determined from 1,217 ascensions and 3,838 observations, taken at elevations of 1,000 feet or more, was 5.0° for each 1,000 feet, or 0.4° less than the true adiabatic rate. The largest gradient 7.4° per 1,000 feet, was found up to 1,000 feet, and, thereafter, there was a steady decrease up to 5,000 feet, the rate of decrease becoming less as the altitude increased. The gradient up to 5,000 feet was 3.8° per 1,000 feet. Above this altitude there is a tendency toward a slow rise, but the lack of a sufficient number of observations above 6,000 feet forbids a definite statement to that effect. The morning gradients were also greatest up to 1,000 feet, and least up to 5,000 feet, and the rate of decrease was about the same as the mean rate, the curves showing a very close agreement in this respect. The average morning gradient was 4.8° per 1,000 feet. The afternoon gradients were larger, but not decidedly so, the average value being 5.8° per 1,000 feet. The greatest rate of decrease is still found at 1,000 feet, and the least up to 5,000 feet if the few observations at 7,000 feet are not considered as of equal weight. When the stations of observations were grouped according to their geographical locations, it was found that the mean rate of temperature decrease with increase of altitude was much greater in the central Mississippi than in the upper Lake region, the central west, or the extreme east, as represented by the single station at Washington. It was 5.8° per 1,000 feet as compared with 4.7° for the central west, 4.6° for the upper Lake region, and 3.6° for the Atlantic coast. There is also a very close agreement between the means for the upper Lake region, those for the central west and the grand mean, and a marked deficiency on the Atlantic coast, where the gradient was 1.4° per 1,000 feet less than the mean rate. These general statements apply also to the morning results. In the afternoon, however, the differences were quite small, the extreme difference being 0.6° per 1,000 feet. The maximum gradient 6.1° was found in the central Mississippi Basin, and the maximum 5.4° in the upper Lake region.

II. RELATIVE HUMIDITY.

"The relative humidities at and above the surface of the earth differed but little except at 7,000 feet, where the surface humidity was 11 per cent. less than that above. With this exception the greatest difference was 3 per cent., and except at 2,000 and 8,000 feet, the upper air percentages were the lower. The mean result obtained from all these observations showed 60 per cent. at the surface and 58 per cent. above, a difference of 2 per cent. The stations at which there were marked differences were Washington, where the mean difference was 14 per cent.; Omaha, where it was 29 per cent.; Springfield, Ill., where it was 21 per cent., and Fort Smith, where it was 12 per cent., the surface humidity being the higher except at Fort Smith. At the remaining thirteen stations, except Lansing, the upper air humidity equalled or exceeded that

Digitized by Google

at the surface, but the difference at no place exceeded 10 per cent. At nine stations the difference was 5 per cent. or less."

III. VAPOUR PRESSURE.

The vapour pressures are expressed in percentages obtained by the formula $\frac{P}{P^0}$ in which P represents the vapour pressure at any given altitude, and P^0 that observed simultaneously at the earth's surface. The mean of the percentages thus obtained was 59, and there was a steady, though not by any means uniform, decrease with increase of altitude. The percentage at 1,500 feet was 82, and at 8,000 feet 44. The decrease was most rapid between 2,000 and 5,000 feet, where it averaged 9 per cent. for each 1,000 feet. The decrease between 5,000 and 6,000 feet was only 3 per cent., while between 6,000 and 7,000 feet it was 10 per cent. The lowest percentage, 52, was found at Omaha, and the highest, 77, at Pierre.

SOUNDING THE OCEAN OF AIR: Six Lectures delivered before the Lowell Institute of Boston in December, 1898, by A. Lawrence Rotch, S.B., A.M., Director of the Blue Hill Meteorological Observatory. Society for Promoting Christian Knowledge.

This admirable little volume affords an abundance of information on a subject concerning which the public has hitherto had little opportunity of gleaning any adequate idea. But while it partakes of the popularity of style which is a distinguishing feature of the Romance of Science Series, there is much in its pages that will be welcome to the scientific reader, and no scientific library should deny a place for the book on its shelves.

In the introductory chapter there is some well-compiled general information on the nature and extent of the atmosphere, the exploration of which is the subject of the book under review. The reader may well direct his attention to Plate I., a glance at which will probably give him a clearer conception of comparative altitudes in the atmosphere than he has ever had before. The diagram represents a vertical section of the lower portion of our atmosphere. On the right is a scale of miles above the sea, and on the left is a scale of barometric pressures corresponding to the height. On the right-hand half of the diagram we are shown the eastern hemisphere, with the Himalaya Mountains, on the left-hand half the western hemisphere, with the Andes. There are also depicted the height of the different kind of clouds which are measured at Blue Hill, and which form the subject matter for a whole subsequent chapter. Then we can see the highest mountain meteorological stations in the world, those on Mont Blanc, and El Misti in Peru, the highest inhabited place—a monastery in Thibet, and the greatest height to which a mountaineer has climbed—on the Andes. About half a mile higher than the Himalaya Mountains is placed a balloon to represent the height reached by Messrs. Glaisher and Berson in a balloon in 1862 and 1894 respectively, as has been before mentioned in this journal. A discussion has lately arisen as to which of these aeronauts reached the highest point; and it would seem as if the point is destined to remain for ever undecided. It is true that Mr. Berson produced an observed record of 30,000 feet, whereas Mr. Glaisher's last observed record before he fainted was 29,000 feet. Some weight should, however, be given to the opinion of Glaisher, that after the last observation was made the balloon reached 37,000 feet before descending. After this object in the diagram, comes a great gap, the monotony of which nothing breaks, until we come to the average of the three highest ascents of a ballon-sonde in 1894, which is fourteen miles, more than double the height of the ascents of Messrs. Glaisher and Berson. This shows at once the value of the ballon-sonde as a means of penetrating the atmosphere. A contrast to the height of the ballon-sonde is afforded by the position of the kite flight from Blue Hill in 1898. Though kites cannot be reasonably expected to attain to such heights as the ballon-sonde, still the position indicated in the diagram does not represent the latest achievement in kite-flying at Blue Hill; the record in 1898 being about a mile and a half, while last summer, on July 19th, the record was 15,900 feet.

For observations at the lower levels of the air, it would be difficult to over-estimate the value of the kite, as will be fully realised by the readers of chapter VI. in Mr. Rotch's book. The least conspicuous object in this comparative diagram is the Eiffel Tower—a thousand foot measure. So insignificant does it appear compared with the other altitudes represented, that it almost escapes notice. But on one point, observations on the Eiffel Tower claim superiority over those taken on lofty mountains, for they are secured under fairly isolated conditions, and are not handicapped by the disturbing conditions attending mountain observations.

Chapter II. deals with the Blue Hill observations on Clouds; and treats of their formation, classification, and measurement. The observation of clouds is one of the most systematic means that we at present possess of observing the movements of air currents, an observation full of interest to the aeronaut, for the horizontal currents are, at present, his motive power. Every light, therefore, that can be thrown upon aerial currents by the observation of cloud movements is of extreme value to aerial navigation. The contents of chapter II. show that the method of observing clouds at Blue Hill has been eminently successful. For twelve years the amount of cloud at each hour of the day has been recorded at Blue Hill. The maintenance of personal observations at each hour of the night is arduous; and, therefore, an automatic instrument has been used at Blue Hill, which, in Mr. Rotch's opinion, deserves to be better known. This is called the "Pole Star Recorder," and a complete description of the instrument will be found on page 48.

A diagram which the reader may study with advantage, is Plate IV., page 57, giving the heights and velocities of clouds measured from Blue Hill. An interesting passage in the text is that treating of the motion of the clouds at higher levels. "The average velocity of cirriform clouds is ninety miles an hour in winter and sixty miles in summer, but occasionally in winter cirrus have been found to have the enormous velocity of two hundred and thirty miles an hour. In the average, the velocity of the currents increases, from the lowest to the highest clouds at the rate of about three miles an hour for each 1,000 feet of height, but near the ground the increase of height is faster. It has been found that the velocity of the lower clouds is less than the velocity of the wind on a mountain of the same height, which may, perhaps, be explained on the supposition that the mountain acts like a dam to accelerate the flow of air over it. The measurements in Sweden showed that the middle and upper levels of clouds are higher than in America, but that they move less rapidly. This may be because the surfaces of equal temperature in the air are higher in the United States than in Sweden, on account of the direction of the upper currents, while the greater velocity of our high clouds correspond with the more rapid movement of areas of low and high barometric pressure over the United States.

The results are suggestive. For instance, the energy of the upper half of the mass of the atmosphere, or that portion which lies above 18,000 feet, has been calculated to possess six times the energy of the lower half in which we live, and, as yet, none of this enormous store of energy is applied to the use of man. While it appears certain that no navigable balloon or flying machine will ever be able to stem the enormous velocity of the upper atmosphere, rarified though it is, perhaps in the future, aerial machines will take advantage of the prevailing currents of the high atmosphere as our sailing ships do of the trade winds."

Chapter IV. is devoted to the subject of the "Ballons-Sondes" or self-recording balloons, and gives us a concise history of their use and description of the self-recording instruments they carry. It was in April, 1895, that the ballon-sonde cirrus rose to the extraordinary height of 72,000 feet, more than 13¼ miles, where the barometric pressure was reduced to one and a half inches of mercury. The comparative warmth recorded (—50° Fahrenheit) has led Dr. Arsman himself to doubt the accuracy of the usual methods of registering temperature at such extremely low pressures. This is a very important point to determine, as if the results of these high ascents are erroneous, the value of the ballon-sondes would be much diminished. The question, therefore, of accuracy, should be thoroughly investigated, and if the present forms of apparatus do not secure it, it is hardly too much to expect that modern ingenuity cannot remedy the defect.

One of the greatest triumphs connected with the ballons-sondes was M. Cailletet's ingenious apparatus to bring down samples of air from the high regions. This will be found fully described on page 112. Another contribution of M. Cailletet, described in the same chapter, is an apparatus for measuring the height of the balloon by photography, in order to verify Laplace's formula connecting the barometric pressure with the altitude. Another instrument designed for the ballons-sondes, and fully described, is M. Violle's actinometer to determine the solar constant.

Chapter V. deals with the history and application of kites to meteorological purposes at Blue Hill and elsewhere, and is undoubtedly the best summary of the subject that has hitherto been published if we make one exception, by the omission of the name of Major Baden-Powell, in connection with the development of the kite. It is true that Major Baden-Powell's work has rather tended to show the usefulness of the kite in war than as a meteorological instrument, but he has produced a very efficient kite of his own de-

sign, and has done much to attract public attention in this country to the kite method of raising bodies into the air.

Chapter VI. treats entirely of the scientific results of kite ascents. These are already numerous and important. As has been mentioned in another part of this journal, Mr. Rotch is preparing a special paper for a meeting of the Aeronautical Society of Great Britain, on the actual discoveries made by means of kites. This will contain the latest information on the subject. In the meanwhile members of the Society and others interested in scientific kite flying will do well to peruse the last chapter of the work under review.

An interesting subject which kite flying may in the future elucidate, is the origin of cyclones and anti-cyclones. Data is given in the chapter mentioned, which has called for the following remarks of Mr. Rotch, with which we will conclude this review.

"The study of these data indicate that the cyclonic and anti-cyclonic circulations observed in this latitude do not embrace any air-movements at greater altitudes than 2,000 metres, except in front of the cyclone, when the air appears to be carried upward to a great height. Above 2,000 metres there are probably other weak cyclones and anti-cyclones or secondary ones, with their centres at different places from those at the earth's surface, and producing a different circulation of wind. The observations of the cirrus clouds at Blue Hill indicate that at their level exists a cyclonic circulation above the anti-cyclone apparent at the earth's surface. The shallowness of our anti-cyclones would be inferred from the great differences in speed of the general atmospheric drift, for since the velocity of the general drift from the west is more than thirty times greater at 10,000 metres than it is at 200 metres, a circulation of great depth could not endure long. Cyclones and anti-cyclones appear to be but secondary phenomena in the great waves of warm and cold air which sweep across the United States from periodic causes.

The origin of cyclones and anti-cyclones is, perhaps, the most important problem remaining for meteorological study. The theory that they are produced by differences of temperature in adjacent masses of air, or as it is called, the convictional theory of the American meteorologists, Espy and Ferrel, is opposed by the observations on mountains in Europe which were collected by Dr. Hann, of Vienna. If the question can be solved by the use of kites, as seems to be foreshadowed by the results just stated, another foundation stone will be laid in the science of meteorology, and the status of the kite, established as an instrument of research."

By Land and Sky. By the Rev. John M. Bacon, M.A., F.R.A.S. (Isbister and Company, London.)

The literature of travels in the air is, at present, not over abundant. So much the more welcome is every new addition to the records of those who have braved the perils of ballooning in hopes of enriching our practical experience of aeronautics and our general knowledge concerning the atmospheric envelope of our planet. "By Land and Sky," by the Rev. John M. Bacon, is a graphic and picturesque description of travels in the air, and will be read with interest and pleasure. Indeed, from its peculiarly vivid accounts of the sights that can be seen, and the sounds that can be heard from the car of a balloon, it should win many a recruit to the noble cause of ballooning.

The present volume cannot, however, be called a scientific treatise on discoveries in the atmosphere. Possibly, Mr. Bacon has not yet given to the world the whole contents of his note book, and is reserving some special results for a second and less popularly written volume. Anyhow, in the book under review, there is an absence of the strict methods of research which alone have the power of wresting secrets from Nature. Consequently, we search in vain for any definite scientific conclusions, even in the acoustical experiments. In making this mentioned criticism it is by no means wished to disparage the praiseworthy efforts of Mr. Bacon or to undervalue his dauntless courage, which quality renders him so peculiarly fit for the work he is undertaking. It is rather suggested that in future expeditions, the results might be increased in their value if he were to concentrate his energies upon some more definite plan of research. In the present volume there are several circumstances mentioned which are suggestive of subjects of research for future ascents. For instance, the author's energies might attack the imperfectly understood motions of horizontal aerial currents at different altitudes in different directions, which are full of promise as a natural means of aerial locomotion. Where can these be studied as well as from the car of a balloon? Again, in many places, Mr. Bacon mentions the presence of the vertical currents of the atmosphere and their effect upon the stability of the balloon

Digitized by Google

in the air. Still less is known about the motions of the vertical currents than those of the horizontal ones; but they have an important bearing on both meteorology and aeronautics, and a determination of their causes and an exact measurement of their forces would be of extreme value.

But if the work lacks definite scientific conclusions, it abounds in incidents, adventures, and narrow escapes. The greatest instance of the latter is afforded in the chapter entitled "In Quest of the Leonids," when Mr. Bacon and his daughter ascended in a valveless balloon, and so dramatic were the incidents of the voyage under these peculiarly dangerous conditions, that the reader must indeed be of a calm frame of mind who does not become breathless when he reads this tale.

Mr. Bacon is an expert photographer from a balloon, and amongst other photographs has added, as an attraction to his volume, that very excellent and clear photograph he secured at a height of 1,000 feet above Clifton. Another photograph taken by Miss G. Bacon records one of the perils of the voyages. "Descent across a telegraph wire." This lady must be congratulated on her skill as a photographer, but still more so on the absolute bravery she has displayed in being the companion of her father on his fascinating aerial voyages.

Meetings of the Permanent International Aeronautical Congress.

January 17.

At a meeting of the Permanent International Aeronautical Congress at the Institute on January the 17th, several new sub-committees were nominated, and their work will be the furthering of the following resolutions of the Congress of 1900:—

To interest governments in the publication of aeronautical documents and records, in the formation of balloon parks or private aeronautical laboratories, and in the methodical training of civil aeronauts.

The publication of an Aeronautical Formulary or Guide Book.

The drawing up of a technical instruction on kites.

The consideration of the measures necessary to bring about simultaneous international ballon-sondes ascensions. The Congress emphasised that private societies must share in these experiments.

The means of securing the safety of aeronauts in high ascents.

February 21.

In this sitting the Permanent International Aeronautical Congress concluded its examination of the resolutions of the Congress.

All resolutions relating to the title of "aeronaut-commander" and the rights and duties conferred by it are referred to the sub-committee of the "Aeronauts' Certificates."

The resolutions touching Custom House questions and the carriage by rail of aeronauts and their accessories are referred to the sub-committee of the Aeronautical Formulary or Guide Book.

A further sub-commission is charged to effectuate the resolution concerning the lowering of the price of gas supplied to aeronauts.

In conclusion, the Secretary-General read his summary of the Proceedings of the Congress of 1900 which will be published by the Administration of the Universal Exhibition.

March 21.

The Permanent International Aeronautical Commission in this sitting at the Institute of France under the Presidency of Professor Hergesell, approved a work read by Commander Renard on behalf of the Sub-Commission of Asphyxiation by Arsenated Hydrogen; this paper contained a memorandum by Captain Richard on the researches into this question in 1900 at the Chalais Establishment, and on preventive and curative measures, various extracts from the Registers of the Experimental Department of the Laboratories of the School of Mines, and a memorandum from Surgeon-Major Maljean on cases of arsenical jaundice observed in aeronauts anterior to 1900.

Naval-Lieutenant Tapissier, delegate of the Permanent Commission, at the approaching Congress of the International Maritime Association, read his report on the conditions in which the salvage of balloons at sea should be carried out, and on utilising aeronautical aids in maritime salvage.

Lastly, M. Hervé, also a delegate to this Congress, presented an historical appreciation of what has been done in this direction by kites and balloons since the last century, and also an account of all similar official and private experiments carried out at different epochs by the principal maritime nations.

International Ascents, Dec. 6, 1900.

Communicated by PATRICK Y. ALEXANDER.

PARIS (Trappes). I. Ballon-sonde, 2 hours before sunrise, launched. Landed near Freiburg (Baden).

II. Ballon-sonde, 8 a.m. launched, landed at Strassburg i. E.

III. Too windy for manned balloon.

STRASSBURG. I. Registrir balloon, launch not possible; too stormy.

II. Registrir balloon, System Teisserenc de Bort, with Teisserenc de Bort and Hergesell apparatus, launched 10.15 a.m., landed near Biberach, a. d. Riss. H., 6,000 metres. T., - 20° C. Speed of wind 40 metres per sec.

III. Manned balloon. Launch not possible; too stormy.

BERLIN. Aeronautical Observatorium. I. Registrir balloon, System Teisserenc de Bort and Tuess. Launched 5.7 a.m., landed 13 kilometres from Tegel. H., 2,900 metres. T.,—6° C.

Registrir balloon, 7.49 a.m. launched. H., 2,572. The balloons could not pierce through the clouds on account of snow ballast.

VIENNA. Ballon-sonde, passed away to the east; results not yet known.

ST. PETERSBURG results not yet to hand.

BATH, England. Ballon-sonde, launched 11.32 a.m., landed Baydon, between Swindon and Hungerford. H., 2,300 metres.

NOTES.

The Effects of Vertical Aerial Currents on Balloons.—In the Quarterly Journal of the Royal Meteorological Society for January last will be found a most interesting note on "Thunderstorm Observations during a Balloon Ascent," which is a translation of a note by Dr. R. Börnstein, published in the *Meteorologische Zeitschrift* for August, 1900:—

It appears that on June 8th, 1900, the balloon "Condor" ascended from Berlin, manned by three lieutenants of the Prussian Balloon Corps, who witnessed some remarkable electrical phenomena from their vicinity to a thunderstorm.

"The balloon was moving from south-west at about 11.30 a.m., at a height of 2,300 feet, just over Kaulsdorf (about 5 miles east of Berlin), and was enveloped in cloud, but occasionally the earth was visible through chinks in the cloud. The chief balloonist, Lieut. de la Roi, heard a sharp crackling sound at the ring of the car, like the noise of sparks from a large electrical machine, and when he looked up, he saw a spark 27 inches long, and about 0.5 in. in section, move up at an angle to 120° to the car ring. Lieut. Prin reported that while a flash was passing he saw the ring illuminated, and at the same time heard loud crackling. Lieut. Davis noticed 'an electrical spark like a lightning flash pass between balloon and car, with a loud hissing sound.' Thunder was heard before and after this phenomenon, and the supposition is that at this moment the thunderstorm was above the balloon."

These electrical phenomena were attended by one of those downward currents which can occur from various causes, and often prove fatal to the maintenance of a balloon in the atmosphere. In this case it appears that the pressure of the descending current was so great that the balloon descended with such rapidity, that the ballast provided, and which, under ordinary circumstances, would have checked the rate of descent, proved quite unavailing, and the balloon reached the ground with a discomforting bump. This was a striking example of the influence that vertical currents can exert on balloon voyages.

If an adverse horizontal current can conduct aerial travellers in an opposite direction to which they wish to go, an adverse vertical current can quickly terminate an aerial expedition, and the dependance on the caprices of both horizontal and vertical currents emphasises the necessity of nicer means of regulating the vertical motion of balloons. It is not surprising that aeronauts are looking forward with much interest to practical experiments with Monsieur Aimé's "Thermosphere," described in the last number of this journal, and which is an ingenious attempt to improve the vertical motion of balloons.

The Projected Balloon Trip across the Mediterranean.—By no means the least interesting of the aeronautical events promised for the coming season is Count de la Vaulx's projected balloon voyage across the Mediterranean. We are indebted to the correspondent of the *Daily Mail* for the following facts. The material of the balloon is to be French silk. The car will be made of rushes and will measure 2 metres 80 c.m. by 3 metres 20 c.m. Amongst the four

Digitized by Google

passengers, will be Lieut. Gentz, director of naval ballooning at Toulon. Every attempt will be made to keep up communication with the coast from the balloon, and in order to carrying out this intention, wireless telegraphy experiments and carrier pigeons will be taken up, also electric lights for signals. An attempt will be made to establish a line of communication between France and the African coast by utilizing the different aerial currents, and attention is promised to pure scientific research. It is proposed to start in June or July, at which period both the sea and air may reasonably be expected to be at their calmest. The car is to be provisioned for three weeks. It may, indeed, be hoped that this journey will not come to as abrupt conclusion as did that of Dr. Berson's great and provisioned balloon last September.*

Aeronautical Exhibits at the Royal Institution.—On the occasion of Dr. Bryan's discourse on the History and Progress of Aerial Locomotion at the Royal Institution, several objects of aeronautical interest were effectively displayed in the library, which largely contributed to the illustration of the professor's discourse. The exhibits included an historical series of lantern slides illustrative of aerial navigation, the property of the Honorary Secretary of the Aeronautical Society, the new emergency Bruce patent electric signalling balloon, which had just been received back from the Paris Exhibition, an admirable selection of box kites of every size, including the very pretty form of kite in imitation of a ship, lent by Messrs. Pain and Co., and some excellent specimens of photographs from balloons at great elevations by Mr. Percival Spencer.

Soaring Machines.—Dr. Bryan, in his recent interesting lecture at the Royal Institution, dwelt at some length on the subject of "Soaring Machines," and showed several illustrations of the machines of the late Mr. Pilcher and Mr. Octave Chanute. He considers that there is a future for the soaring machine in spite of the tragedies which have been connected with its manipulation, and advocates new enterprise in this direction.

Soaring machines have, however, been peculiarly disastrous to past experimenters, and if fresh attempts are to be made to gain in this way experience in the balancing movements of soaring birds, it becomes essential that the investigators should be protected in their experiments from the chances of those fatal falls which made both Lilienthal and Pilcher martyrs of science. Such protection might be afforded by means of large nets slung beneath the aerial spaces where the soaring machine is to hover. These safety appliances are afforded to acrobats in their so-called flying leaps and bounds from bar to bar and other gymnastic evolutions. Why, indeed, should it not form part of the preparations for the still more hazardous exercises of soaring?

The Return Journeys of the Navigable Balloon, "La France."—The recent experiments of Count Zeppelin have called for comparisons between the journeys made by his monster balloon, or, rather, combination of balloons, and those made by Captains Krebs and Renard in 1884. With their electrically-propelled aerostat "La France."

There appears, however, to be some confusion in the public mind as to the actual accomplishments of the latter air craft, and a tendency to underestimate its performances, which, in spite of the recent experiments of Count Zeppelin, is undoubtedly the best example of balloon navigation against the aerial current, though it did not succeed in doing more than overcoming a very light wind.

In the accounts that Captain Renard sent in to the French Academy in 1885 concerning the experiments, it is stated that out of seven experiments the balloon returned five times to the place whence it started. Those who may be interested in the details of this balloon will find a very complete description of its construction in Tissandier's "La Navigation Aérienne." It is a remarkable fact that on the 28th October, "La France" executed two ascents and two return journeys on the same day. The details and charts of these journeys will be found on page 313 of the above-mentioned work.

But one of the most satisfactory experiments was on September 22nd, 1885. On this occasion we are told that the wind blew from the north north-east from Paris at a velocity of from 3 to 3.50 metres per second. Starting from Meudon, the balloon was directed towards Paris at 4.25 p.m. It crossed the railway line at 4.55 p.m., reached the Seine at 5 o'clock. At 5.12 the balloon entered the enceinte by the bastion 65. Then the aeronauts decided to go home. The balloon was easily turned, and, aided by the aerial current, reached the exact spot whence it had started. The part of the journey against the wind took forty-seven minutes, the part with the wind eleven minutes. On

* See *Aeronautical Journal*, January, 1901, page 16.

Digitized by Google

the day following, a similar journey was performed successfully.

Kite-Flying Records.—Mr. Rotch writes concerning the article in the January issue on the Vincennes competitions, that the higher record there assigned to M. Teisserenc de Bort for kite flying was attained, not in the kite competitions at Vincennes as stated, but in M. Teisserenc de Bort's observatory at Trappes. Mr. Rotch mentions he was a juror in the Vincennes Kite Competitions. The French authority, however, for the statement in our issue couples this ascent with the record of the competitions.

Obituary.

PROFESSOR G. F. FITZGERALD.

We regret to announce the death of George Francis Fitzgerald, Erasmus Smith Professor of Natural and Experimental Philosophy in the University of Dublin, and who was an esteemed member of the Council of the Aeronautical Society of Great Britain. He was born in Dublin in 1851, and educated at the same college in which he afterwards held an important post. He was a Fellow of the Royal Society. In 1888 he was President of Section A British Association. To him was entrusted in 1896, the delivery of the Helmholtz Memorial Lecture before the Chemical Society, and in 1899 he was the recipient of a royal medal from the Royal Society "for his brilliant contributions to Physics," the most conspicuous of which were his researches in radiation and electrical theory. Professor Fitzgerald is a great loss to the Aeronautical Society, in whose objects and work he took the deepest interest. Since the foundation of the New Aeronautical Journal, he has contributed two papers to its pages one on "Experimental Soaring," October, 1898, and another on "Sailing Birds," July, 1900.

Foreign Aeronautical Periodicals.

On this list a selection of some of the most notable articles is given.

L'AERONAUTE (Paris).

October, 1900.—Congrès d'Aéronautique (2me article) Travaux des Sections.—L'Incident Fonvielle.—Etude Comparative sur la Déviation des Ballons.

November.—Les Concours de Ballons de l'Exposition de 1900: M. Eugène Godard.—Congrès International d'Aéronautique de 1900 (2e section).—L'Aviation Militaire: M. Ader.

December.—Les Léonides en 1900: Mlle. Klumpke.—Les Aéronautes du Siège de Paris: M. E. Aimé.—La Direction des Ballons: M. E. Aimé.

January, 1901.—Concours Internationaux d'Exercices Physiques et des Sports.—La Logique de la Navigation Aérienne: Le Prince Dimitry-Tzerteleff.

February.—L'Avenir de la Navigation Aérienne (2e article).—Le Vol à Voile et l'Aviation: M. J. Pillet.

L'AEROPHILE (Paris).

January, 1901.—Portraits d'Aéronautes Contemporains: M. Henry Deutsch de la Meuthe (E. Aimé); La Défense d'Andrée (W. de Fonvielle); Le Ballon Dirigeable du Comte Zeppelin (E. S.).

February.—Portraits d'Aéronautes Contemporains: M. Georges Juchmès (Georges Besançon); Le Ballon du Comte Zeppelin (J. Subzberger).

ILLUSTRIRTE AERONAUTISCHE MITHEILUNGEN (Strassburg).

January, 1901.—Ueber die Bedeutung Luftelektrischer Messungen in Freiballon: Dr. Hermann Ebert.—Bericht uber den Stand der Versuche Mit Einem Drachenflieger: W. Kress.

Notable Articles.

1901.

Jan. 2. *Daily Express.*—"4,500 feet above Earth."
5. *Daily Mail.*—"A South Pole Balloon."
9. *Times.*—"Count Von Zeppelin's Air-Ship."
17. *Standard.*—"Ballooning on the Baltic."
18. *Daily Chronicle.*—"Aerial Currents and Navigable Balloons."
24. *Church Family Newspaper.*—"The Progress of Aeronautics." A Chat with Mr. Percival Spencer.

Feb. 8. *Daily News.*—"The Art of Flight."
9. *Morning Leader.*—"Scientific Ballooning."

Digitized by Google

Feb. 28. *Daily News.*—"Aerial Navigation."
Mar. 2. *Morning Post.*—"French Balloon Enterprise."
3. *New Penny Magazine.*—"Flying by Kite."
15. *Morning Leader.*—"The New High Flyer."
28. *Morning Post.*—"New Air Ship."

Applications for Patents.

(*From December 28th, 1900, to March 22nd, 1901.*)

List of Applications for Aeronautical Patents during December (1900), January, February, and March, 1901. Compiled by Bromhead & Co., 33, Cannon Street, London, E.C.

23,108. December 28, 1900. Ernst Cuyer, 72, Cannon Street, London, E.C. Improvements in Flying Machines.

23,845. December 31, 1900. Andrew Herbert Byran, and Alexander Reid Baird, 111, Hatton Garden, London, E.C. An Aerial Machine and Improvement in Apparatus in Connection with suchlike Machines.

346. January 9, 1901. Arthur Henry Philip Blunt, 104, Albert Street, Regent's Park, London. An Improved Flying Machine.

883. January 23, 1901. Patrick Joseph Flynn, 23, Coleman Street, London, E.C. Improvements in Air Ships.

1,066. January 23, 1901. George Vicholl, 45, Southampton Buildings, Chancery Lane, London. Improvements Relating to Flying Machines.

1,489. January 30, 1901. Joseph Henry Dillon-Gregg, 55, Chancery Lane, London. Machine for Aerial Navigation.

1,899. February 6, 1901. Heinrich Hildebrand, 15, Took's Court, Cursitor Street, Chancery Lane, London. Improvements in Flying Machines or Aeromobiles.

2,166. February 6, 1901. Stanislaus Victor Saloni, F2, Cannon Street, London. Improvements in Steerable Air Balloons.

2,658. February 13, 1901. Anton Weczera and Lewis Wells Broadwell, Lydian House, Westbury Gardens, Loats Road, Clapham Park, London. Improvements in Flying Machines.

2,749. February 13, 1901. William Biles, 130, Portway, West Ham Park, West Ham, Essex. Propelling Vessels or Flying Machines.

3,691. February 27, 1901. Maurice Leger, 18, Buckingham Street, Strand, London. Improvements in Flying Apparatus.

4,089. March 6, 1901. Auguste Eugene Gaudron, 42, Chancery Lane, London. Improvements in Navigable Balloons.

Digitized by Google

620.5
A245

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s

UNIV. OF M
AUG 4 1

THE AERONAUTICAL JOURNAL



Edited for the Council of the Aeronautical Society of Great Britain

By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 19. JULY, 1901. VOL. V.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AERONAUTICAL SOCIETY	37
THE FORTHCOMING GENERAL MEETING	37
GENERAL MEETING OF APRIL 15—	
1. "AERONAUTICS IN FRANCE." BY WILFRED DE FONVIELLE. (*Illustrated*)	38-43
2. THE METEO-PARACHUTE. BY ERIC STUART BRUCE.	43-44
"ECHOES OF THE SIEGE OF PARIS" (REPRINTED BY KIND PERMISSION OF THE EDITOR OF THE *Daily News*)	44-45
"NOTABLE BRITISH BALLOON ASCENTS." BY PERCIVAL SPENCER	45-47
"THE ANGLE OF INCIDENCE." BY WILBUR WRIGHT	47-49
THE INTERNATIONAL BALLOON ASCENTS	49
NOTES—AERONAUTICAL EXHIBITS AT THE CRYSTAL PALACE EXHIBITION—DR. C. ZIMMERMAN'S "CYCALA" FLYING MACHINE—REMARKABLE KITE FLIGHT—DR. BARTON'S FLYING MACHINE—M. LOUIS GODARD'S PROJECTED BALLOON VOYAGE ACROSS THE ATLANTIC—THE BALLOON RAILWAY—NEW AIR-SHIP ON LAKE CONSTANCE	49-51
FOREIGN AERONAUTICAL PERIODICALS	51
NOTABLE ARTICLES	51
APPLICATIONS FOR PATENTS	52

LONDON:

PUBLISHED BY THE AERONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., GOUGH SQUARE AND BOLT COURT, E.C.

Digitized by Google

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL :—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G. F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901,

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

THE AERONAUTICAL JOURNAL.

JULY, 1901.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road, Kensington, London, W.

NOTICES OF The Aeronautical Society.

At a meeting of the Council held at the Society of Arts on Monday, April 15th, 1901, the following gentlemen were elected members of the Society:—

Major F. C. TROLLOPE (late Grenadier Guards.)

Mr. L. W. BROADWELL.

The following gentleman was elected a member of the Council:—

Major F. C. TROLLOPE.

Resolved, that Mr. Patrick Y. Alexander's offer to financially assist the Aeronautical Society to the extent of one hundred pounds per annum for five years should be accepted and the warmest thanks of the Council should be conveyed to Mr. Alexander for his most generous gift.

GENERAL MEETING.

The next General Meeting of the Aeronautical Society will take place at the Society of Arts, John Street, Adelphi, on Monday, July 15th, at 8 p.m. Major H. C. Roberts will take the chair.

On this occasion a special series of photographs representing the British War Balloon Operations in South Africa, taken on the spot, will be exhibited by the electric lantern.

The following papers will be read:—

"The Chief Scientific Uses of Kites," by Mr. A. Lawrence Rotch, Director of Blue Hill Observatory, U.S.A.

Notes on:—

1. "Sounding the Air by Flying Machines controlled by Hertzian Waves," illustrated by working models.
2. "The Hofman Flying Machine," illustrated by lantern views.
3. "Rotary Kites."
4. "Behaviour of Screws Rotating in a Horizontal Plane when exposed to Currents of Air," by Mr. Patrick Y. Alexander.

"Balloon Photography at Great Altitudes," by Mr. Percival Spencer, illustrated by photographs taken from balloons.

Members are reminded that they have the privilege of introducing two friends to the general meetings of the Society.

Members and correspondents of the Aeronautical Society are reminded that the present address of the Aeronautical Society is 19, Campden House Road, Kensington, London, W., and that all communications should be addressed to the Honorary Secretary to that address.

ERIC STUART BRUCE,

Honorary Secretary.

GENERAL MEETING.

A General Meeting of the Aeronautical Society of Great Britain was held at the Society of Arts on Monday, April 15th, 1901. Major H. C. Roberts occupied the chair.

The CHAIRMAN: Ladies and Gentlemen—We commence our proceedings this evening by asking our Honorary Secretary, Mr. Eric Stuart Bruce, to be good enough to read to us the minutes and proceedings that have taken place in connection with the Society since we last met here.

The SECRETARY read the minutes, &c., including the address of condolence to the King and His Majesty's reply, published in the AERONAUTICAL JOURNAL, April, 1901.

The CHAIRMAN: As you are already aware, Mons. Wilfred de Fonvielle, Ex-Annual President of La Société Française de Navigation Aérienne, and who has distinguished himself very much in aeronautical science, has been good enough to come over especially from Paris to address the members of the Aeronautical Society of Great Britain on "Aeronautics in France," when he will describe the progress made since his escape in a balloon from Paris during the siege of 1870, and he will also discuss the actual prospects of aerial navigation.

"Aeronautics in France."

BY WILFRED DE FONVIELLE.

Mr. Chairman, Ladies, and Gentlemen,—Although feeling desirous not to tax your patience this evening, it is my duty to apologize for addressing so influential an audience in the English language instead of my native French. If I am doing so it is not owing to any forgetfulness of my lack of the many qualifications which distinguish the English debater, especially as it is so long since I visited your prosperous shores; but I was told by my friend, Mr. Eric S. Bruce, your Honorary Secretary, whose wishes are binding to me, that I could not offer a more welcome compliment to a British Society than in using the British tongue this evening. The air being the freest of all elements, is not the tongue of the freest of all nations the most fit for the discussion of aerial matters?

I must begin by acknowledging the great honour passed upon me by your Society in electing me as a honorary member of an Institution which ranks so high in public estimation and which includes so many illustrious names on its list of members. I will also offer you my best thanks on behalf of my friend, M. Jaques Faure, with whom I have been associated on the present occasion. If my countryman could have been present, which was an impossibility, as he left France a month ago for China, I am sure he would have considered that the honour bestowed upon us is a compliment to our common motherland. For my own part, I will try to show my gratitude by giving you some useful information relating to the progress of aeronautics in France.

But though, in the present address, I shall strictly confine myself to the principal aeronautical questions at present discussed in France, on my return to Paris I shall be glad to communicate by letter with any one of your members interested in any special branch of the subject of aeronautics.

At the last Aeronautical Congress held in Paris, when Major F. C. Trollope represented the British Government, Monsieur Janssen, the President of the Congress, set forth a great idea, which was endorsed by all the aeronauts assembled under his chairmanship. He said, on this great occasion, that the conquest of the air is not destined to promote the ends of any nation in particular, but to develop at large the welfare and enlightenment of mankind. This truly philosophical view is splendidly supported by aerial facts. It is true that the rather keen interest felt by the general public for the progress of aerial navigation can be almost exclusively attributed to the glorious service rendered by ballooning to France, when, 30 years ago, she was forsaken by the God of War. But it can be asserted that essential progress in aeronautics has been also produced by many efforts not having any warlike tendency.

The first balloons sent up in Paris 117 years ago before admiring crowds were hailed as opening magic ways for travelling at any distance with the velocity of the wind. They

were the swiftest means of travelling then known; for at that time there were neither railways nor steamers nor automobiles. Then it was supposed that this new way of communication could be used, either by selecting in the atmosphere a stream of air convenient to the purpose, or by forcing one's way toward a determined point by paddle, rudder, or even sails.

But it was soon discovered that very often the aerial ocean is moving in a single direction, and at all events, that it is not possible to know beforehand where the wind will carry the balloons after they have reached a determined altitude.

Besides, the mechanical efforts tried with hand-power proved feeble and were sometimes attended with tragedy, several experimenters being burnt to death, drowned, and killed by being precipitated from the car. Then the public lost interest in aerial experiments, expressing for them nothing more than the curiosity felt in witnessing a prize fight or the performance of tight-rope dancers or fire-eaters.

It cannot be said that aeronauts were rescued from the miserable position of being ranked amongst mountebanks by Science only, even using that term in the broadest acceptation, and making it synonomous with Philosophy, Poetry, and Art.

In the air there is nothing to trade for or search after except grand ideas and magnificent conceptions relating to the harmony of Nature and the reverence for Divine Providence.

The air contains no untold treasures to be discovered by the microscope or caught by delicate nets. The only treasure to be found there by scientists is perhaps some cubic inches of a rare gas, such as helium, and this is of no marketable value except for the spectroscopist who could not possibly pay for it a large sum of money.

I think that the great helper of Science in conquering the air is unquestionably athletics. Is it not likely that aeronautical sports will become popular in this great country of sports, which is visited by all the sportsmen of the world in order to be instructed in sporting matters—rowing, sailing, yachting, horse racing, polo, golf, cricket, and other similar amusements.

But am I not making a great mistake in determining a time when aeronautical sports will become popular in this country? Have they not already been popular for a long time?

I could not undertake to mention all the celebrities who have crossed the British Channel in a balloon since the voyage of Blanchard, but I will make mention of the performances of your good old Green, of General Brine, Sir Robert Couroney, and Powell, the plucky member of the House of Commons, who found a watery grave. Nor can I forget the brave Colonel Burnaby, with whom I once had the pleasure of ascending from the Crystal Palace, and who so soon after this happy and joyful balloon trip gallantly shed his blood for his Queen and Country in the Soudan.

Up to the present hour I have only once had the honour of seeing the Reigning Majesty of England. It was in 1898, when the great Giffard balloon was ascending in La Cour des Tuileries. The then Prince of Wales arrived with his suite; they ascended at once. His Royal Highness was wafted up into cloud-land by Gaston Tissandier. I ordered the band to play "Rule Britannia" when the party landed, and afterwards "God Save the Queen." The Prince appeared to enjoy the trip, and expressed his satisfaction in such terms that one cannot help hoping that King Edward the Seventh will prove a royal patron of aeronautics in your land where captive balloons made their appearance in 1869, but, I am sorry to state, with very little success. The gross amount collected by the Giffard captive balloon ascents amounted to no more than £200, a very poor income indeed for covering expenses surpassing £20,000. But the prestige of royalty is so great in this land that this trip produced a revolution in the English opinion. Just after the royal visit of 1898, Giffard could have covered all his expenses at once if he had been willing; the story is rather amusing, and it is a nice illustration of the character of the celebrated engineer. On the following day, just when the royal visit was reported by the London papers, a gentleman applied to Giffard as immediate purchaser of the balloon, proposing to take possession of it only at the close of the exhibition. He offered to pay £30,000 in cash, and at my suggestion Giffard accepted. But on the morrow when the would-be purchaser returned to Giffard's home in order to draw up the deed of agreement, Giffard asked what his idea was in purchasing the balloon, to which he replied that he had arranged for ascents to be made from the Crystal Palace grounds. On hearing this, Giffard said: "Very well. I have no objection to it if no one is allowed to step into the car, and the balloon is to go up, not with passengers, but merely with ballast." As soon as the gentleman

Digitized by Google

heard the extraordinary condition put on the bargain, he took up his hat and angrily left the room. When we were alone, I asked Giffard why he had lost the opportunity of cashing so large a sum of money. He did not try to explain, but gave a trivial reason. I suppose that really he was afraid of the grave responsibility which he would have had as the constructor of the balloon. If such was the case, Giffard was quite right, as in 1899 the balloon could not continue its ascents up to its allotted time, the canvas having been burnt with sulphuric acid. The balloon, when at anchorage, was torn to pieces by the wind.

I am of the opinion that one can fitly compare aeronautics to an immense bird which is supported in the air by its two wings, one of its wings being science, the other sport. By using both wings with discretion, wisdom, and daring, this immense bird can make conquest of the air. It is not, therefore, a matter for wonder that in France we have established two different Societies, each of which is devoted specially to one of these two wings. These two Societies are living in friendly intercourse together. They can be said to be working hand in hand for the same end; as even the days of meeting are so arranged that it is possible to be present at both. Our actual President of the Societe Francaise de Navigation Aerienne is the Prince Roland Bonaparte, who is also the President of the Scientific Committee of the other Society. The Societe Francaise de Navigation Aerienne was organised shortly after the Franco-Prussian War as soon as peace and order were restored on the territory of the French Republic. It was established by Paul Bert, Herve, Mangon, and other friends of Gambetta who were members of his short-lived Grand Ministry. In the Chair there have been successively a large number of illustrious academicians, and politicians such as Berthelot Janssen, Eugene Spuller, the Minister of Public Instruction. The Secretary of State is ex officio the patron of this Institution, which, within a very few days, will be declared an establishment of public interest for France.

One of our members, Eugene Farcot, an engineer and a siege aeronaut, bequeathed us a sum of £4,000, which is to be spent in the directing of balloons; a part of this sum will probably be used this present year. We intend to celebrate our coming of age by some appropriate festivities. We hope that the Aeronautical Society of Great Britain will send a delegation on that occasion.

The younger Society is the Aero-Club, which has been in existence only for a few years; but, as Corneille says in the tragedy of the "Cid":

"Chez les ames bien nées,
La valeur n'attend pro le nombre des années."

So this Society has already acquired a well-earned world-wide fame.

I shall have the honour to present your Association with the yearly book of the Aero-Club. This volume shows that the interest in ballooning is fairly developing amongst the upper classes of France. The time is fast approaching when every leader of high life in France will think it his duty to spend some time in the higher regions of the atmosphere. At all events the revival of aeronautics on the French side of the Channel must be considered as being a corollary of the surprising success of automobolism. Indeed, the Automobile Club itself has most powerfully furthered the development of the Aero-Club. The members of the Aero-Club are permitted to use for our dinners, meetings, and lectures the magnificent rooms of the splendid hotel which the Automobile Club purchased in the Place de la Concorde. I will deem it a great honour if, at our next monthly dinner, I may introduce some of you to our table, where you will find a truly French hospitality and welcome. But to return to aeronautics, is it not natural that the astounding performances realized on land by the petroleum machine should have made men ambitious to try this wonderful apparatus in the air, and to give wings to the auto-velos, wings that were wanting in order to give full reason to Plato, when he says that "Man is a featherless bird."

The Aero-Club is very prosperous, as can be proved by the following statistics: In the year 1900, the receipts amounted to about £2,450 and the expenses to £1,200, leaving an increase of £1,250. In that year 144 ascents were made, consuming more than 6,000,000 cubic feet of gas. Four hundred people were carried up in the air, the total duration of all these trips being 1,200 hours, which gives for each balloon a mean duration of 8 hours and 20 minutes. The average length of each course was the unprecedented number of 400 k.m.s., and there were almost always three people in the car. Some of these Aero-Clubbists have already won a name in the history of science. I may mention here Comte Henri de la Vaux and Comte Castillon de St. Victor, who covered a distance of 1,925 k.m.s.; and Jacques Balsan, who reached an altitude of 8,000 metres. If these numbers are compared with those of 1899, we find that

the amount of gas spent in 1900 is four times greater, that the total length of the distance run over is three times larger, that the total duration of the trips is four times longer, that the number of passengers is three times more considerable, and that the record of the distance run without landing is one thousand nine hundred and twenty-five, against one thousand three hundred and thirty-six, the mean duration of each trip being 35 hours 45 minutes.

It is true that some historical scientific balloon ascents were executed in Paris by Biot and Guy Lussac in 1801; but, nevertheless, Professor Bryan was justified in his address delivered recently before the Royal Institution, in stating that the balloon had been engaged in the service of Science by the British Association. It was this great Society, which put into execution the schemes which had been thought out by Arago in 1843, and it was your distinguished countryman, Mr. Glaisher, who executed the first series of scientific observations executed with a definite purpose by means of instruments which had been specially constructed, and who discovered the first general laws of the Meteorological Phenomena of the Great Atmosphere. Mr. Glaisher secured his observations in the car of his balloon with the same care, precision and correctness as if he had been seated in the Meteorological department of Greenwich Observatory. His work was popularised throughout the whole of Europe and America by "Travels in the Air," which was originally published in English and French, and was translated into the Swedish, German, and Russian languages.

One of the first steps taken by the Societe Francaise, was to organise a series of scientific ascents which would rival those of Mr. Glaisher. In 1875, a magnificent balloon bearing the name of "Zenith," was constructed, funds being raised by subscription, and also by the Government. The beginning of the enterprise was attended by success, and the Zenith made some notable ascents. But, unfortunately, the aeronauts relied too much on a new means of inhaling pure oxygen for compensating the rarity of the gas contained in each dose of air introduced into the lungs; and on one occasion, when the Zenith was navigating an upper level of the air, two of the travellers were found to be dead. The cause of this catastrophe had for years been considered a mystery, but recently it has been explained by some incidents connected with the balloon races held in Paris on the occasion of the last exhibition.

One of the competitions was for altitude reached, and the prize was taken by two aeronauts, M. Balsan and M. Louis Godard, who had procured a bag of oxygen and used it in the upper part of the trip. The process which proved fatal in the Zenith catastrophe had become usual in Germany and in England as exemplified by the successful ascent to more than 8,000 metres by M. Arthur Berson and Mr. Percival Spencer.

On the occasion of the balloon race for altitude, M. Louis Godard had placed in his mouth the pipe of the oxygen bag when he reached the moderate altitude of 4,000 metres; but M. Balsan refused, saying, "It will be time enough to begin the inhalation when I commence to feel uneasy. Then M. Godard continued the throwing of the ballast, and soon the aeronauts reached the really dangerous level. But then Godard saw that his friend was turning pale and fainting. He had been taken by surprise, and could not find the presence of mind required for putting the pipe in his mouth. Then M. Godard rushed at him and placed the pipe in his mouth, employing considerable force in introducing it into his lips. M. Balsan soon recovered, the first dose of pure oxygen having produced the known effect, and he was quite right. But this took a little time, and during the interval, M. Godard had not used the inhaling pipe, so he turned pale and fainted and would have been lost if M. Balsan had not rendered him the very service he had received from him. These incidents cannot be disregarded in the history of the Zenith Catastrophe. The aeronauts should have commenced to inhale the oxygen at the first feelings of inconvenience, and have not waited until it became impossible for them to make use of the process.

In consequence of the Zenith catastrophe, a member of the Societe Francaise started a scheme for building a glass cage wherein the aeronauts should be located so as to be preserved against the mortal effects of the rarity of the air. This proposal was submitted to close investigation by a special committee, but it was found after careful calculation that the cage was too heavy for being carried at such a distance from the earth; as, for instance, Mr. Glaisher reached, so the proposal was rejected. Last year another member made a new proposal to devise a diving suit or aerial scaphande. The scheme has been received with favour, and it is now under examination; but it is doubtful if one could ever get rid of several disqualifications.

The Zenith catastrophe was a black spot in

the history of the Societe Francaise. It collected funds for erecting a monument to the memory of the illfated aeronauts and for giving compensation to their families.

The Zenith balloon itself was sent to the Conservatory of Arts as a relic. This starting of a scheme for collecting aerial observation with ballons-montes, was transferred to Berlin, where a splendid series of 75 ascents have been executed, and their results published in three quarto volumes, edited at the expense of the Emperor of Germany. Many scientific ascents were made in France, but in regular series to be compared with those of Mr. Glaisher.

The French, however, discovered new means of exploring the atmosphere. MM. Hermite and Besancon first conceived the idea of sending up ballon-sondes, which means balloons carrying up self-registering apparatus. These experiments have been carried out with a great success; so great, indeed, that an international commission was started for controlling the sending up of ballon-sondes from different parts of Europe. In these international ascents the five leading Powers of Europe are represented: Austria, France, Germany, Russia and Great Britain, the latter being represented by Mr. Patrick Alexander, one of your keenest members for the progress of aeronautics.

This Association is very prosperous, the ascents of the balloons are taking place once a month, and the number of them is increasing. On the last sending up on the 7th March last, not less than 12 were sent up, and of these 12 only one had not been recovered a few days after the ascents.

A great improvement on the original scheme has been realised by M. Teiserenc de Bort, the Director of the Trappes Observatory. Instead of using silk balloons of 300 to 400 cubic metres as Messrs. Hermite and Besancon did, he is sending up paper balloons of 60 cubic metres, which are a miracle of lightness. In filling them even with ordinary coal gas he sends up his registering apparatus to the height of 101,000 metres or more. But, for the success of the operation, it is necessary not to expose these frail and light fabrics to the tearing power of the winds. Consequently, M. Teiserenc de Bort invented a shade which can be pivoted so that the opening is always opposed to the wind, so that the starting is always safe under any circumstance. It is too soon to review the various results obtained through this method, which is to develop gradually all round the world, and to last, certainly, longer than the present century. But it may be said to be to the credit of your great countryman that, despairing to wrest a higher level record than that secured by M. Glaisher, the French aeronauts resolved to build another Glaisher in steel, and in glass, and in copper, who can, without danger of suffocation near the frontier of the pure ethereal medium, report every one of his observations by curves traced by an unfailing hand.

The International Committee, against my own opinion, are arranging for sending up with the ballons-sondes a certain number of ballons-montes, in order to control their observations at lower levels. It is, however, in my opinion, almost useless to employ eye observations for controlling mechanical records. There are strict limits to the susceptibility of the human eye and quickness of impression, even of a Glaisher; but there is none to the velocity and delicacy of a registering apparatus, especially when photography is employed, as is possible in many cases.

Though I speak thus, I am not an adversary but an advocate of the sending up of ballons-montes under some circumstances. There are so many fascinating phenomena to be observed in balloon excursions, that it is to be regretted that so many occasions are lost for inspecting the celestial bodies, because observers confine their exertions to the reading of barometers, thermometers, and hygrometers, which can be done as easily by proper mechanism.

A great path has been opened out through the initiative taken up by M. Janssen, the illustrious director of the Meudon Observatory. In 1889, he sent observers for the first time to look after the November displays of the falling stars; and this step was only the beginning of the forthcoming numerous applications of the balloon to astronomical purposes. It is to be deeply regretted that the occasion of the hour was lost, and that the Persean Star was left without anyone making a balloon ascent to witness the variations of its light when clouds obscured its view from observers on the earth. For this indifference and neglect, the astronomers of the present time will have to bear the reproach of posterity.

After the delivery of this address, M. De Fonvielle exhibited to the meeting a large collection of excellent photographic lantern slides, descriptive of the progress of aeronautics in France; and amongst the most striking were a series descriptive of self-recording apparatus connected with the ballon-sondes, and a fine series of views representing the Vincennes competitions. He also ex-

Digitized by Google

hibited cinematograph pictures of M. Santos Dumont's navigable balloon, which were received with much applause. The exhibition of the cinematograph films which had been lent by M. Santos Dumont, was rendered possible by the kindness of Mr. Paul, who generously placed at the disposal of the Aeronautical Society his excellent cinematograph apparatus, and personally attended to its manipulation.

The CHAIRMAN: Ladies and Gentlemen, I think you will agree with me that we have to return our very cordial thanks to Mons. Wilfred de Fonvielle for the trouble he has taken in coming over from Paris to address us, and I ought to mention that by an unfortunate accident he lost the paper which he intended to read to us this evening, and the consequence is that he has been employing himself for many hours to-day in endeavouring to reproduce it. We all know the difficulty that he would be in under any circumstances, but for a gentleman who is addressing us in a foreign language it must be indeed very trying. I ask you, therefore, to pass the following resolution: "That the cordial thanks of this meeting be offered to Mons. Wilfred de Fonvielle for his very interesting paper on 'Aeronautics in France,' and for the view of the photographs and the cinematographs which he has been kind enough to exhibit to us."

The resolution was adopted with acclamation.

The CHAIRMAN: Mr. Charles Groombridge, a member of the Aeronautical Society, had intended to exhibit his new propeller, but unfortunately an accident has happened and he will not be able to do so: I will, therefore, ask Mr. Bruce to be good enough to show his meteoparachute, a new instrument for investigating the upper atmosphere.

THE METEO-PARACHUTE.

By E. S. BRUCE.

Mr. BRUCE: This apparatus called the meteoparachute, is very simple in form, but I think it will add considerably to the practical use of the ballon-sonde of which Mons. de Fonvielle has told us so much that is interesting this evening. As you will have understood, the ballon-sonde at the present time is sent away with the recording instrument. These recording instruments are very expensive, and it is a chance as to whether they are ever recovered. As a matter of fact, one sent up very lately fell into the sea, but I believe I am right in stating that the apparatus was rescued. The meteoparachute is a device by which at any moment we choose to fix beforehand, we can bring down to the earth the recording instrument. If, for instance, we want it in ten minutes, or half



The Vincennes Balloon Competition—Preparing for the Race.

Digitized by Google

an hour, or an hour, we can set this clockwork arrangement so that it will release the meteo-parachute at the given time and it will bring down the recording instruments in a gentle manner so that they will not be broken. For this we depend upon the principle of the parachute, a principle which has been very much neglected and which simply depends upon the resistance of the air. I am now going to haul the apparatus up to the top of the room together with the model parachute and thermometer attached, and you will see when we set it to a certain time, the parachute with its freight will descend at the given moment. This, of course, is the apparatus in a rough form. We have a more special arrangement when we send it up with the balloon. (Experiment.)

Mr. BRUCE afterwards exhibited, in action, a model of a navigable balloon, which illustrated how balloons could be steered in a calm atmosphere. The experiment was received with much applause. He also showed on the screen a series of photographs illustrating the trial trips of Count Zeppelin's airship.

The CHAIRMAN: This ends our programme, ladies and gentlemen, and we thank you for your attendance here and for the way in which you have shown your appreciation of the exhibits.

Sir HIRAM MAXIM: Ladies and Gentlemen, I beg to move a vote of thanks to our Chairman for the able manner in which he has conducted the business of the evening.

Mr. E. P. FROST: I have much pleasure in seconding that.

The CHAIRMAN having acknowledged the vote of thanks, the proceedings terminated.

Echoes of the Siege of Paris.

In reference to M. Wilfred de Fonvielle's recent visit to England to address the Aeronautical Society, the "Daily News" published the following interesting article which is reprinted below by kind permission of the editor of the "Daily News."

M. Wilfred de Fonvielle, who last night addressed the Aeronautical Society, in the Hall of the Society of Arts, is a man with a past, of which, however, he need feel no shame. Not only is he ex-President of La Societe Francaise de Navigation Aerienne, but he was one of the first entrusted during the siege of Paris with the organization of the balloon service from the capital to the provinces. In previous years he and MM. Flammarion, Eugene Godard, and G. Tissandier had seen with apprehension the neglect of ballooning by the French Government. They did what private people could to fill the void, but still they lamented. Since 1794 the country of Montgolfier, the land claiming to be the birthplace of aerial navigation, had not possessed an Aerostatic School. Quelle honte! When the war with Germany broke out, M. de Fonvielle and M. Tissandier offered to accompany the army of the Rhine with captive balloons. They were not even answered. As the latter gentleman drily remarked, "General Lebœuf was determined to depend on his own genius. He would not have known what to do with balloons." The Government of the 4th September showed a different spirit. On the 20th of that month the Paris Post Office could no longer communicate with the outer world, and three days later the first balloon of the new service went up from the capital. M. de Fonvielle made the thirtieth ascent, with four companions. He had meant to use the captive balloon of the Exhibition of 1867, but was luckily disappointed. It split when filled, the silk having no doubt rotted. Hauled to the ground that the rent might be mended, the great gas-filled bag escaped from both net and car, rose into the air, and fell between the French and German lines, where it became a captive in earnest. Had M. de Fonvielle gone up with it, he might not have lived to speak last night. The loss caused him to use L'Egalite, with a capacity of 3,000 cubic metres, or nearly 4,000 cubic yards. Filled at the Vaugirard Gas Works, L'Egalite ascended at ten in the morning of the 24th November, and in four hours and a quarter touched ground at Louvain, Belgium, a remarkably rapid and successful passage. M. de Fonvielle did not return to Paris while the siege lasted. The Germans would not let him. But the service he had helped to form continued triumphantly. Sixty-four balloons left la ville lumiere, the last ascending on the 28th January, 1871. They took in addition to the aeronauts, 91 human passengers, 363 carrier pigeons, and 3,000,000 letters, weighing about 22,000 lbs. Of the 64, five were captured and two lost at sea, with their passengers. It is a record of which the men responsible might well be proud, especially as the aeronauts were chiefly sailors, the number of experts being insufficient. The Germans did their best to hinder the balloon service. They watched constantly for the air-ships. When-

Digitized by Google

ever they saw one they telegraphed to their posts in the direction it was taking. Krupp made a special gun to fire at balloons, and more than once the enemy found them within rifle range. A large share of this kind of excitement fell to Gambetta. With his secretary, Spuller, and the aeronaut, J. Trichet, he left Paris on the 7th October, 1870, making the fifth ascent during the siege. The balloon lacked lifting power. Crossing the German lines near St. Denis, it was only 1,900 feet above ground. Cannon balls and rifle bullets sang unpleasantly close to the travellers. They threw ballast overboard, and escaped, but shortly afterwards mismanagement brought the balloon rapidly to earth not far from a German post. Out went more ballast, and once again the hope of France rose superior to misfortune. Passing near Creil at a height of only 650 feet, his balloon was seen by soldiers of Wurtumberg. They ran to their rifles, which, luckily, were stacked. Gambetta and his companions spied the danger. Sacrificing more ballast, they mounted to a height of 2,500 feet, followed by a fusillade which did some trifling damage, one of the Dictator's hands being grazed by a bullet. A third time they were fired at. It was near Montdidier, and under circumstances which seemed to suggest that the Germans were bad shots. The balloon had sunk nearly to the ground, and could not be raised, for the precious ballast had all gone. A party of the enemy, camped on the outskirts of a wood, made a target of it, but in vain. Passing over the wood, the balloon was caught by the upper branches of an oak, and Gambetta's aerial voyage came to an end. With the help of some peasants he alighted, and reached Montdidier, whence he went to Amiens to pass the night.

Notable British Balloon Ascents.

By Percival Spencer.

After a series of balloon ascents extending over many years, I may truly say that each new ascent made differs in some manner from previous ones, and new interest and new experiences always await the aerial voyager. It was in 1898 that I had the pleasure of accompanying Mr. George Griffith on a balloon trip from the Crystal Palace to France. On the 3rd of February we made our first attempt, the day was dull and the balloon was rapidly wafted over Chatham and Canterbury; all was drear and gloomy, and though the course of the wind was such that we could have speedily crossed, we could not hope to obtain photographic records of the voyage; and, therefore, landed in England, and made another attempt on the 8th of the same month. On this occasion a bright sky and a brisk breeze gave promise of a fine trip, and so it proved. At heights varying from double that of Snowdon to but a few hundred feet we continued our course over land and sea to Verchin, in the Pas de Calais, my companion's record of which was set forth in print in "Pearson's Magazine" illustrated with blocks made from the photos we secured. We travelled at thirty miles an hour, and easily landed in four hours after our start.

Balloon ascents for the instruction and entertainment of visitors have for many years formed a feature of the programme of the Annual Gala and Flower Show held at York, no less than six ascents being made during the three days of the Show. Parties of passengers are made up for each balloon, and some delightful trips over the Yorkshire wolds result. I have secured some of my finest balloon photographs in the clear air of York; that of the City, Minster, and Old Wall having been already published in this journal.

Whilst these right-away balloon ascents from the most pleasant and undoubtedly the practically best form of ballooning, the captive balloon has come more to the front for use by naval and military folk. Seated in the car of a balloon held captive by a steel or hemp cable the soldier can spy out the country for miles round, and it is only necessary to mention the eulogistic dispatches from the generals in the recent South African military operations, to show the value in which the balloons were held. For naval purposes, the sailor's range of vision can be vastly extended. The horizon no longer need remain but a few miles away. At 1,000 feet thousands of square miles are within range of vision. Whilst the naval authorities have not yet adopted balloons, it is worthy of record, that Lieutenant H. O. Arnold-Forster and other officers of H.M.S. "Vernon" conducted experiments with a suitable balloon at Portsmouth last year. They made the hydrogen gas, inflated the balloon, and succeeded in obtaining bird's-eye views of the whole of the harbour and fortifications.

At the British Association meetings, for the last three years, I have made ascents with

the Rev. J. M. Bacon, whose experiments in mid-air have revived the scientific interest in the subject. Not only the records of dust-counters, hygrometers, and air samplers has Mr. Bacon obtained, but he has also, either at Bristol, Dover, Bradford or Newbury, carried on experiments with aerial bombs, wireless telegraphy, and collapsing drum signals. The bombs consist of a cartridge of guncotton which is suspended some hundred feet beneath the car, and ignited by pressing the button of an electric battery in the car. A terrible explosion results, the balloon and air are shaken with its force, and loose portions of twine, paper, etc., which may have accumulated on the balloon are loosened and flutter down to the car, but the noise does not hurt. After a lapse of about a quarter of a minute, the exact length of time is carefully noted, the echo returns from the earth, and reverberations continue for some time. Echoes from the earth, and from clouds seen and unseen, are the object of the observations. The wireless telegraphy experiments such as were carried out from Bradford to Sheffield, on the 10th September last, consist of taking in the car some three hundred pounds weight of telegraphic instruments, and hanging a pendent wire from the balloon. A wire also runs up a lengthy pole fixed in the grounds at the point of start, and by this means communication is maintained between the earth and the balloon as it floats away into the distance. These experiments were a pronounced success, and as such, warrant further investigation. The collapsing drum signals are a means of communicating to the earth from the balloon as the country is passed over. The drum, when open, is a conspicuous object as it hangs from the balloon, and is easily shut and opened from the car by a string. Anyone understanding the Morse Code can read the messages. Whilst passing over the camps on Salisbury Plain on August 29th last, messages were flashed up to the balloon by heliograph, and replies sent.

On two occasions last season I was aloft in terrible weather, when storm clouds were around, and when lightning flashed everywhere. The ascent from Newbury with Admiral Sir Edmund Freemantle and Mr. Bacon and his son has been graphically described as in "the heart of a thunderstorm." The morning had been fine, but at the hour of the ascent clouds closed in. A considerable wait was made, during which there had been rain, thunder, and lightning. In a lull as it were, hoping that the storm had passed we ascended; but no sooner had we left the earth than a fine specimen of lightning-flash passed through the air ahead, reaching from the black cloud above to the dark earth beneath us. Then started hail, rain, lightning and thunder all around, and after passing Hungerford and Savernake Forest we decided to get down out of it; and landed at Mariboro'. The following week—it was at Ilkeston, in Derbyshire, on August Bank Holiday last—I had another similar experience, which has not been reported. In company with a local gentleman I went up in the calm before a storm. We soon were in the midst of such a scene as I have described above. The storm clouds were all around ever and anon bursting into lightning flashes. In half an hour we had travelled to Mansfield, and descended. Before the balloon had been emptied, the storm was upon us, such a storm too. Within a quarter of an hour of the start, tents were being wrecked in the grounds from which we had started, and all the fury of the storm had burst upon them. The balloon ran before it, and as I have explained, had descended and was about empty before it overtook us. These ascents raise a most important question for meteorologists and balloonists, namely, if a free balloon forms an attraction for lightning or not. The question has been asked, but I have not yet seen a satisfactory answer.

Of balloon trips of interest, I think my Cross-Channel ones most worthy of mention. On four occasions recently has the silver streak been crossed. Of the first I have already made mention. On the second occasion, accompanied by Mr. Lawrence Swinburn, I crossed on the 20th December—almost the shortest day in the year, but, nevertheless, one which proved bright and fine. On this occasion we were testing sails and dragropes over the water, and succeeded in diverting the course of the balloon from that of the wind to an appreciable degree. London to Havre in four hours was the record of that voyage. Again, on the 29th July, on the occasion of a Crystal Palace Fete Day, Mr. C. F. Pollock and I, in the Crystal Palace Balloon of 36,000 cubic feet capacity, sailed for five and a half hours, over Tunbridge Wells, Hastings, and the sea, until France was reached. Not, however, before all ballast, bags, cloths, and even the grapnel had been thrown overboard to keep the balloon aloft. The Frena Camera, however, with its faithful records, was kept intact. On the 15th September, Mr. P. Y. Alexander and I had a speedy trip from Dover to Gravelines by

balloon, carrying a message from the British Association in England to Scientific Confreres in France. The "Sketch" contained an account with photographs I secured.

It is unnecessary to more than mention the numerous balloon ascents, parachute descents, ascents of the monster Fish Balloon, shaped and decorated according to nature, made by myself and brothers, throughout the length and breadth of the country. But perhaps I should not close this paper without referring to the new aeronautical premises now erected by Messrs. C. G. Spencer and Sons at Highbury Grove. Here is the only specially-designed establishment for the purpose in this country—including a hall with curved roof sufficiently large for the inflation with air of the large-sized balloons, in order that they may be examined, repaired, or dried. From this establishment the present season witnessed the advent of eight fully-equipped passenger balloons with aeronauts and assistants on one day. Four of these were to make simultaneous ascents in London on the 1st May on behalf of the "Sun" newspaper, and duly ascended with observers in the car of each balloon from West Ham, Barnes, the Welsh Harp, and the Crystal Palace; whilst the other four balloons, used for the purposes of advertisement, left for South Wales, where they also satisfactorily started ascents with parties in the car of each on the 1st May, in Cardiff, Swansea, Newport, and Pontypridd. Thus it will be seen that there are ample facilities for the future of balloon investigation in this country, and with the ever increasing interest in the subject, no doubt each year of the new century will be able to chronicle further progress.

PERCIVAL SPENCER.

Angle of Incidence.

By Wilbur Wright.

If the term "angle of incidence," so frequently used in aeronautical discussions, could be confined to a single definite meaning, viz., the angle at which aeroplane and wind actually meet, much error and confusion would be averted. But many of the best writers use this term loosely and inexactly, with the result that their calculations and explanations of phenomena are thereby often rendered of little value, and students are misled.

If a plane be held stationary in a horizontal wind (Fig. 1), the angle of incidence A C D will be equal to the angle with the horizon. But if the wind have an upward trend, the angle of incidence will be increased to A C D^2. A calculation based on the assumption that A C D still remained the true angle would, of course, be seriously in error.

If it be assumed (Fig. 2) that the wind moves from D^2 to C, while the plane moves from E to C, the angle of incidence will become A C D^3. The wind having an apparent horizontal speed of F C+E C, which is equal to F^2 C, as compared with a vertical speed of D^2 F, the wind will appear to strike the plane from the direction D^3 C, thus making its angle of incidence A C D^3 instead of A C D^2.

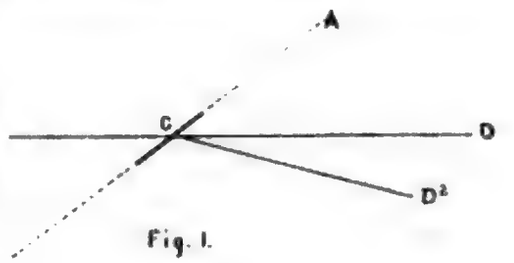


Fig. 1.

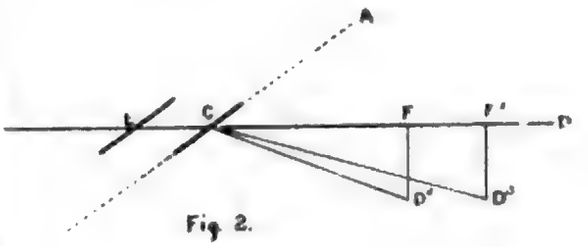


Fig. 2.

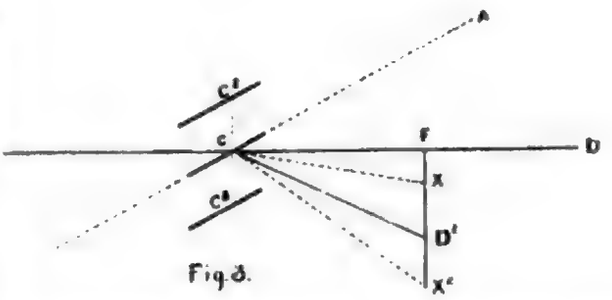


Fig. 3.

Taking still another case (Fig. 3), in which the wind moves from D^2 to C, while the plane is rising from C to C^2 the angle of incidence will be A C X. The horizontal speed of the wind will be F C, and its apparent vertical speed D^2 F−C C^2 = X F, so that the wind will appear to strike the plane from the direction X C. If the plane had fallen from C to C^3 the angle of incidence would have been A C X^2, since the vertical motion would now have been D^2 F+C C^3 = X^2 F.

A study of the foregoing will lead to the conclusion that in order to obtain the angle of incidence, it is first necessary to know correctly (1) the angle of the plane with the horizon; (2) the horizontal speed of the wind; (3) the vertical speed of the wind; (4) the horizontal speed of the plane; (5) the vertical speed of the plane. Now, since the probability of obtaining five correct simultaneous measurements is very slight when the observation is taken in the open air, and since the soaring angle is not supposed to exceed three degrees, it is evident that calculations based upon observations of soaring birds are of exceedingly doubtful value.

But though direct attempts to calculate the angle of incidence promise little for accuracy, another method remains by which approximately correct results may be obtained. The tables of Langley, Lilienthal, Chanute, and others give with a good degree of accuracy, the vertical component of the normal pressure at all angles and speeds, both for planes and curved surfaces. Now, since the elements of these tables are four, viz., area, speed, angle, and lift, it follows that three factors being known the fourth may readily be obtained. The angle of incidence may be calculated in any case where speed, lift, and area are commensurable. Of these, area may be obtained by actual measurement. Lift is equal to weight supported, and can also be exactly measured. Speed alone requires to be calculated at the instant the observation is made. Thus the opportunity for error is reduced to a single item, and this the one which affects the result least seriously in case of a slight error. It is easier to measure speeds than angles, and errors are less costly. There is, of course, a possibility of error in the tables, but the results have been confirmed by the experiments of independent observers, and are believed to be substantially correct. Calculations of the angle of incidence based upon this plan would scarcely be so seriously in error as that of a well-known writer based upon observations of soaring gulls, in which he obtained from his measurements of angles and speeds an angle of incidence which called for an upward lift of nearly three pounds upon a two-pound bird. It was his idea that the excess of lift was expended in raising the bird above its original level. This, however, is scarcely a satisfactory explanation of how a lift of three pounds could be applied to a two-pound bird in contradiction of the law that action and reaction are always equal. It would be more reasonable to assume that the excessive lift never existed, but that the upward motion of the bird kept the angle of incidence (Fig. 3) reduced to a point where the lift was just equal to the bird's weight all of the time.

If students of aeronautical problems will constantly bear in mind that (1) area of surface; (2) weight or lift; (3) relative speed are the only factors concerned in determining the angle of incidence, many errors will be detected and much trouble saved. It is clear that a bird, instead of possessing full control of its angle of incidence (as writers sometimes assume), is, in fact, almost powerless to change it. The bird is really itself controlled by a kind of automatic governor, for a gust of wind which tends to increase the lift is balked by the fact that the weight of the bird is not sufficient to furnish the required reaction, and the bird must either float back horizontally with a speed equal to the increase in the velocity of the wind, or it will involuntarily be raised at a speed sufficient to keep its angle of incidence at a point where the increased lifting pressure naturally due to the increased speed will be exactly counterbalanced. Nevertheless the bird can, to a limited extent, affect its area, its weight, and its speed, and thus indirectly its angle of incidence also. Its area may be reduced (and its angle increased) by partly folding its wings, but as, in actual practice, a folding of the wings always accompanies an increase of relative velocity (which produces a decrease in angle), the real effect is to preserve the original angle instead of changing it. The apparent weight may be momentarily increased by a sudden curve in the direction of motion, in which case the momentum of its body acts to produce a centrifugal force which increases the downward pressure on its wings, and thus requires an increase in the angle of incidence to furnish the required extra support. Speed may be controlled by increasing or decreasing the elevation of the bird or its rate of fall. But none of these changes in speed, area or weight, quickly and permanently affect its angle of incidence. The bird can at will vary its angle with the horizon, even to the extent of three hundred and sixty degrees in less than a second, as when it turns a complete somersault in the air; but its angle of incidence probably does not vary as much as one-twentieth of that amount in the same case. It is very important to distinguish carefully between the angle of incidence, and the angle with the horizon, as the latter has nothing at all *per se* to do with the former. By keeping the distinction carefully in mind, the student will quickly obtain new ideas of the correct

Digitized by Google

explanation of the action of the Penaud tail used by Lilienthal, Pilcher, and Chanute; and correct the sequence of cause and effect in many explanations of phenomena which occur in aeronautical writings.

Since the formulation of a principle into a rule often serves to fix it more prominently in the mind, the writer ventures to offer the following:—

Rule.—The angle of incidence is fixed by area, weight, and speed alone. It varies directly as the weight, and inversely as the area and speed, though not in exact ratio.

The International Balloon Ascents.

April 19th.

The following countries joined in the experiments—Austria, France, Germany, and Russia. The number of balloons sent up were nineteen, of which six were manned. As "Nature" points out in a note upon these International ascents, the results of the ascents with manned balloons from Berlin and Vienna had a very remarkable similitude. At Berlin the temperature on starting was 5°6 C. and −25°5 at an altitude of 5,500 metres; at Vienna it was 5°0 at starting and −25° at 5,260 metres. The greatest height attained by the ballons sondes was 11,848 metres at Chalais Meudon, where the temperature was −52°8 C., the next highest record was 11,000 metres at Trappes where the temperature was −62°, and the third was 10,500 metres at Strassburg where the temperature was −54°.

May 14th.

Eighteen balloons were sent up from Berlin, Strassburg, Trappes, Chalais-Meudon and other places. The most interesting result was that of the one sent up from Chalais-Meudon and which has been noted by "Nature." The temperature at starting was 15°8. Zero was recorded at 3,661 m., −50° at 9,640 m., and the lowest temperature −55°8 at 11,025 m. An invasion of temperature afterwards occurred, and at the highest altitude, 15,414 metres, the thermometer registered −32°2.

The absence of ascents from this country is to be regretted, but it may be pointed out that the short period of time during which ballons sondes have been sent up from this country has shown that our insular position is somewhat unfavourable to this method of investigation. A balloon and its recording instruments has already fallen in the sea, though the instruments were recovered. Hence the necessity of having some means of control over the movements of balloons which carry expensive self-recording instruments, when sent up from an island like Great Britain, is apparent. Experimenters are, however, at work, endeavouring to meet the contingency. One attempt is the Meteoparachute, which was brought before the notice of the Society at its last meeting and fully described above. Another, and still later device, is the one being developed by Mr. Patrick Alexander, and which depends upon the action of Hertzian waves for the control of flying machines carrying the instruments. On this interesting new departure Mr. Patrick Alexander will read a paper at the next meeting on the 15th which he promises to illustrate with working models.

NOTES.

Aeronautical Exhibits at the Crystal Palace Exhibition. One of the exhibits attracting most attention and interest at the Naval and Military Exhibition now being held at the Crystal Palace, is undoubtedly the Ladysmith balloon. We have before had occasion to call the attention of the public, in the pages of this journal, to the excellent and unique features of our British war balloon equipment, which is, without an exaggeration, the finest in the world. We have also spoken of the satisfactory work accomplished by the balloons during the South African war. In besieged Ladysmith their utility was most specially valued. There, the observer in the car located the enemy's guns, and directed the enemy's fire with an unerring precision. As will be seen in the announcements of the forthcoming general meeting of the Aeronautical Society, a series of views will be presented, showing the operations of the war balloons in different parts of the campaign. Another interesting exhibit at the Crystal Palace is the historic balloon "La Volta," in which M. Janssen, the Parisian astronomer, made his escape during the Siege of Paris. Perhaps this exhibit may be of greater interest to the public on account of the publication

Digitized by Google

of the story of M. Janssen's escape in the biographical sketch of M. Janssen's life, appearing in the January number of this journal. The management of the Crystal Palace has also announced practical demonstrations of Major Baden-Powell's war kites in the summer programme.

Dr. C. Zimmerman's "Cycala" Flying Machine. — Dr. C. Zimmerman has sent a preliminary communication to the Aeronautical Society respecting his new flying machine. "I am endeavouring to push to a successful issue my idea of a flying machine. I have coined a word meaning literally 'A Wing Wheel,' derived from the Greek 'Kyklos,' a circle, and Latin 'Cela,' a wing. My location is on a ridge of hills about 1,000 feet above sea level and 500 feet above the city of Frederick, which is 5 miles distant. I am laying out a circular track about 12 feet wide and 30 feet in diameter, so as to get a continuous run for my machine, as I expect to reach a speed anywhere from 20 to 60 miles an hour."

Remarkable Kite Flight.—Mr. A. Lawrence Rotch has communicated the news of a very remarkable flight of a pair of kites in the summer of 1900 from the Royal Aeronautical Observatory near Berlin. Five kites which had lifted self-recording meteorological instruments to a height of two and a half miles, broke the wire that confined them to the ground, and the two upper kites dragged it across the country for nearly a hundred miles before they were finally checked, the trailing wire, two miles in length, furnishing a sufficient resistance to keep the kites flying through the night. It has often been pointed out that a kite is a flying machine, therefore it is worthy of note that a flying machine has actually travelled for a hundred miles, and an accident has accomplished what premeditated efforts have failed to bring about.

Dr. Barton's Flying Machine.—Dr. Francis Alexander Barton has devised a flying machine which is a combination of the balloon and aeroplane principle. Between the balloon and car is fixed a horizontal aeroplane, which, when put in operation, causes the machine either to ascend or descend or travel straight at any altitude. At the rear of the machine is arranged a vertical aeroplane for steering to the right and left. As the "Daily Express" points out, the great difficulty that has hitherto been experienced by airship inventors is that of circumventing the disastrous results following the moving of the centre of gravity. This Dr. Barton claims to overcome in the following manner: Two half-filled water tanks are arranged at each end of the car, and when one end of the machine becomes heavier than the other, the water is automatically pumped from one machine to the other.

M. Louis Godard's Projected Balloon Voyage Across the Atlantic.—Sea trips are coming much into favour with aeronauts. The most daring project on hand is the one to be undertaken by M. Louis Godard, who will attempt a journey over the Atlantic. The start is to be made from New York. It has been calculated that the journey will occupy four days. The cost of the enterprise is estimated at £8,000.

The principal novel feature of the huge balloon in which the journey will be made is the attachment of a number of smaller balloons round the equator. These smaller balloons will act as reservoirs of gas. When wanted, the reserve supply of gas will be transmitted from the smaller balloons into the larger one by means of a system of ropes and valves worked from the car. It is claimed that by such a provision of gas the balloons can be kept in the air for sixty days, and travel 15,000 miles without alighting to renew its provision of gas.

The Balloon Railway.—A very novel form of mountain railway has been devised by two Styrian engineers, Herven Balderauer and Brockebusch. The system consists of a captive balloon attached to a single suspended rail to be fixed on to the side of such precipitous mountains as no other form of railway could climb. The balloon is about twelve yards above the rail to which it is secured by a wire cable, and it is worked up and down the side of the mountain by the engineer.

When ascending the lifting power is solely derived from the hydrogen within the balloon. For the descent a reservoir in the balloon is filled with water, which acts as ballast. There is a circular can underneath the balloon through the centre of which the cable passes. It is claimed that during experiments with the apparatus no accident or hitch has occurred. But those who are acquainted with the working of captive balloons will probably suggest that the system will have to be kept for calm weather.

New Air-Ship on Lake Constance.—Lake Constance has been again the scene for a trial of a new air-ship. This is the device of Mr. Henry Suter of Zurich. The ship is propelled by two large air-fans worked on the cycle principle by the Aeronaut, who is seated in a saddle in the cage from which he also directs the steering apparatus. Below the cage are two cylinders, tapering to a point at the ends. These act like pontoons and enable the machine to float on the water. The first trial, however, was not very successful, the machine being driven on to the shore by the wind amongst trees from which it had to be released.

Foreign Aeronautical Periodicals.

On this list a selection of some of the most notable articles is given.

L'AERONAUTE (Paris).

April, 1901.—Notice sur la Poste Aérienne par Pigeons Voyagers pendant le Siège de Paris, 1870-71, par M. L. Van Roosebecke.—Les Aérostiers Militaires pendant le Campagne d'Egypt.—Mémoire présenté au Congrès International d'Aéronautique, par le Baron Marc de Villiers du Tenage.

May.—Communiqué de la Société au Sujet du Brevet d'Aéronaute-Gazogène à Ammoniaque au Chlorine de Calcium, note de M. Josselin.—Ballon plat de M. Georg Lindner de Karlsruhe.

L'AEROPHILE (Paris).

April, 1901.—Portraits d'Aéronautes Contemporains: Alberto Santos Dumont (Emmanuel Aimé); Les Ballons Dirigeables Santos-Dumont; La Traversée de la Méditerranée en Ballon (Henry de la Vaulx).

May.—Portraits d'Aéronautes Contemporains: Albert Tissandier (Henry de Giaffigny); L'Air Libre (Georges Besançon); Au Sujet des Traversées Aériennes au long Cours (Henri Tapissier); 3,000 Kilomètres en Ballon (Maurice Farman); Perfectionnements Apportés aux Aérostats Dirigeables (Baldensperger)

ILLUSTRIRTE AERONAUTISCHE MITHEILUNGEN (Strassburg).

April, 1901.—Zeppelins Zweiter und Dritter Aufstieg, von Oberleutnant Dietel.—Die Hohen, Berg und Luftschiffer-Krankheit, von Dr. Med Carl Scherk.—Weitere Messungen de Electrischen Zerstrenung im Freiballon, von Prof Dr. Hermann Ebort.—Drachenballon Mit Anemometer und Registrirapparat, von Eugen Riedinger.—Meteorologische Zusammenstellungen von Internationalen Ballonfahrten, von Prof. Dr. Hergesell.—Werth und Bedentung der Radflieger fur die Luftschiffart, von Prof. Georg Wellner.

Notable Articles.

1901.

April 27. *Daily Express.*—"A New War Balloon."
Sun.—"Sun Balloons—A Fleet of Sky Searchers."

May 1. *Daily Express.*—"Patriotic Ballooning."
Daily Mail.—"If London were Besieged."

2. *Sun.*—"Sun Balloons—Four Successful Trips."

3. *Military Mail.*—"Aeronautics up to Date—A War Balloon and a Flying Machine."
Daily Chronicle.—"Experiments in the Air."

4. *Illustrated Mail.*—"A Balloon Farm."

5. *Morning Leader.*—"German Manœuvres."

31. *English Mechanic.*—"Hofman's Flying Machine."

June 1. *Sturey's Illustrated.*—"Ballooning Across the Atlantic."

6. *Standard.*—"A Balloonist's Adventures."
Glasgow Daily Mail.—"Flying Machine Trials at Dumbarton."

Applications for Patents.

(April, May, and June.)

Compiled by Messrs. BROMHEAD & Co., 33, Cannon Street, London, E.C.

6,781. April 1. WILLIAM EDWIN IRISH. Improvements in Air-Ships.

7,963. April 18. EDWARD MOTE. The "Moteor" Aerial Machine.

7,990. April 18. ROBERT HENRY BATTERSBY. Improvements in Kites.

8,320. April 23. VICTOR TARRZAL, EDMOND ROHEIM, and JOSEPH SIMKO. Improvements in Kites.

8,369. May 4. RUDOLF COUNT WESTPHALEN. Improvements in Propulsion of Vessels.

9,816. May 11. ALEXANDER LEWENTALL Improvements in Balloons.

9,886. May 13. SIR WILLIAM EDWARD JOSEPH VAVASOUR. Improvements in Water and Air Propellers.

9,977. May 14. JOHN WILLIAM DUNN. Improved Method of Propelling Vessels.

10,589. May 22. JOHN GARDNER. A Method for Controlling and Operating Torpedoes.

10,816. May 25. THADDEUS HYATT. Improvements in Machines and their Mechanism for Navigating the Atmosphere upon a New Principle, and in Means and Methods connected therewith, the Aerostat, as a Toy, being included as a part of the Invention.

11,633. June 7. CHARLES ARTHUR BARRETT (Mellin's Food, Ltd.). Combined Balloon and Parachute for Raising and Dropping Printed Advertising Circulars.

11,948. June 11. FERDINAND LOMBARD Improvements in Balloons.

ENGINEERING LIBRARY

45 Entered at Stationers' Hall.] Price (*to Non-Members*) 1s.

UNIV. O
AUG 4

The Aeronautical Journal



Edited for the Council of the Aeronautical Society of Great Britain.

By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 20. OCTOBER, 1901. Vol. V.

All Rights Reserved.]

Contents.

	page.
Notices of the Aeronautical Society	53
General Meeting of July 15—	53-62
1. The Balloon as the Instrument of Scientific Research.	54
2. The Balloon in South Africa. (*Illustrated*)	54
3. Reply of Lt.-Colonel Templer Concerning the Use of Balloons in the South African Campaign	54
4. The Chief Scientific Uses of Kites. By A. Lawrence Rotch, Director of the Blue Hill Observatory, United States of America	56
5. Notes on—	
(1). "Sounding the Air by Flying Machines Controlled by Hertzian Waves."	59
(2). "The Hofmann Flying Machine." *Illustrated*)	60
(3). Rotary Kites and other New Aerial Apparatus. By Patrick Y. Alexander	60
6. "Balloon Photography at Great Altitudes." By Percival Spencer	61
M. Santos Dumont's Navigable Balloon. (*Illustrated*)	62
The Sparrow Balloon Coins. (*Illustrated*)	64
Reviews.—Aerial Navigation—Balloons and Flying Machines from an Engineering Standpoint. By Octave Chanute	67
Meetings of the International Aeronautical Commission. Translated by H.A.B	68
Notes.—Dr. Berson's Recent High Ascent—The Systematic Exploration of the Atmosphere at Sea by Means of Kites—New Airships: 1. Mr. F. Buchanan's Airship; 2. Mr. W. Beedle's Airship—The Balloon Voyage Across the Channel from the French Side—The Dust Floating above London—The Deutsch Prize.	68-70
Foreign Aeronautical Periodicals	70
Notable Articles	71
Applications for Patents	72

LONDON:

Published by the Aeronautical Society of Great Britain, and Printed by King, Sell & Olding, Ltd., Gough Square and Bolt Court, E.C.

Digitized by Google

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL:—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G. F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901.

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

THE AERONAUTICAL JOURNAL.

OCTOBER, 1901.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
4, Bolt Court, 12, Gough Square,
and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road,
Kensington, London, W.

NOTICES

OF

The Aeronautical Society.

At a meeting of the Council held at the Society of Arts on Monday, July 15th, 1901, the following gentlemen were elected members of the Society:—

Commander ROBERT FALCON SCOTT, R.N.
Mr. E. DOUGLAS ARCHIBALD, M.A.
Mr. HENRY GUY BUTT.

Resolved, that New Rule VI., which provided for the admission of Associate Members at an annual subscription of five shillings, should be rescinded.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

A General Meeting of the Aeronautical Society of Great Britain was held at the Society of Arts on Monday, July 15th, 1901. Major H. C. Roberts occupied the Chair.

The CHAIRMAN: Ladies and Gentlemen,—We propose to commence the proceedings of this evening by asking our Honorary Secretary, Mr. Eric Stuart Bruce to read the Minutes of the Meeting of the Council which took place on the 15th of April last.

The SECRETARY read the Minutes.

The CHAIRMAN: I take this opportunity of asking you to thank, in the name of the Meeting, Mr. Alexander, for his most generous gift. Our Society has never been very much on the right side. I can remember a few years ago, that we had to the good the sum of 4s. 6d. only. Now we find, thanks partly to Mr. Alexander's offer and to the number of new members who have joined us that we have, within a few pence, £150 to the good. (Cheers.) Mr. Bruce will now read a general statement regarding the Society.

MR. ERIC STUART BRUCE: It is usual for the Honorary Secretary of the Aeronautical Society from time to time at General Meetings to make a few remarks concerning the work of the Society. The great object of the Aeronautical Society is the navigation of the air, whether it is to be accomplished by the body lighter than air, the body heavier than air, or by a combination of both balloon and flying machine. But even supposing that its prime object is never completely realised, which the aeronaut will not allow, for he exclaims with the Latin poet "nil mortalibus arduum est," (nothing is too hard for man); yet apart from the question of complete mastery of the air there is, I think, sufficient work before our Society to justify its existence, and the support of the public. The application of aeronautics to pure scientific research is another object of our Society. This object alone is destined to give our Society an importance in the scientific world, which it would be difficult to over estimate. For does not this object link it with nearly all other scientific societies? Aeronautics alone can sever the bond of

Digitized by Google

gravity which chains the observer of every science to the surface of our planet, and places him in new conditions of observation, which must tend to enlarge his conceptions and increase his knowledge.

It would be possible to give a long discourse on the advantages of systematic scientific research in the car of a balloon, to the chemist, physicist, physiologist, and astronomer; but I will confine my remarks to its advantage to the meteorologist.

Nearly all our present meteorological knowledge has been acquired on the surface of the earth amidst those disturbing influences which militate against precise and definite knowledge. Aeronautics can give the meteorologist insight into the meteorology of the free air, that is true meteorology. In this application of aeronautics a splendid field of research will open out before the aerial explorer. What do we yet know about aerial currents, those possible natural air-routes? How long in advance can we now successfully forecast the weather? Is not the weather a series of surprises? Would it be so if we had more definite knowledge concerning the great laws which regulate the cyclonic and anti-cyclonic conditions. Aeronautics and meteorology are, therefore, most essentially united. It might, perhaps, be well if the organisation of systematic aerial meteorological research was undertaken jointly by the two societies, which represent aeronautics and meteorology. For the successful carrying out of aerial experiments, such an organisation would need: (1) the sinews of experiments—ample funds. (2) the co-operation of the meteorological observers in their several departments. Concerning the former, I do not feel doubtful that if an aerial research fund was once well started it would receive an equal amount of public support, as the liquefaction of gases or Arctic exploration.

To-day we have before us an example of the generosity of one of our own members in the service of aeronautics.

Against systematic research in balloons in this country, it will be urged that such a system of research is not fitted for Great Britain, as the balloon is in constant danger of being wafted out to sea beyond our Islands. But in this imperial moment, is Great Britain any longer an island? Is there not now a Greater Britain, containing many lands, each larger than half the European Continent? We have, therefore, a choice of many climates in determining which is best suited to the requirements of aerial research.

After all, is it impossible to obtain good results even in our breezy islands? Was not the recognised highest ascent undertaken and successfully carried out by Mr. Glaisher, from England. Coxwell, the great aeronaut, who piloted Mr. Glaisher, knew full well that for such a high ascent, our insular position was a difficulty; but in the words of Lord Lyndhurst, he also knew that a difficulty is "something to be overcome." He knew that in attention to small detail there is almost magic power, and on foresight in his preparations he relied for the success attained. It will be generally admitted that for scientific ascents in this country, an important needed improvement in the balloon is the better control of its vertical movements. Therefore, the experiment contemplated by Dr. Barton (one of the members of our Society), of building an airship, one of the principal features of which will be the control of its vertical movements, will be looked forward to with the most intense interest by the aeronauts of every nationality.

The CHAIRMAN: We now propose to exhibit by means of the lantern, a special series of photographs representing the British War Balloon Operations in South Africa, which were taken on the spot.

The photographs were then exhibited.

MR. ERIC STUART BRUCE: In exhibiting these photographs we can say with truth that the War in South Africa has afforded the greatest object-lesson on record of the use of the balloon in warfare, and that it has shown that we possess the finest Military Balloon equipment in the world. (Cheers.) As I see that we are honoured by the presence of Colonel Templer, I should like Colonel Templer to say which he considered to be the chief positions of utility in the balloon operations in South Africa.

Col. TEMPLER: Ladies and Gentlemen,—I am sure anything I can tell you will be a great pleasure to me. Perhaps I might mention that the second balloon section went to Ladysmith, and got up just in front of the sailors whom you heard so much about. They had to go, of course, very urgently and quickly from the base, and so only a part of the detachment went on and got into Ladysmith just before they were besieged. I was not there myself, but the observations were carried out for them as long as the balloon and gas would last, which was about 29 days. Sir George White told me when he came out that I sent him a splendid section, and the balloon did everything for the defenders; it not only located all the Boer guns and their

positions, but it also withdrew all the Boer fire on to the balloon. Several balloons were



Lord Roberts's Army advancing towards Johannesburg: 84th Battery and Balloon Corps.

[By kind permission of Messrs. Underwood and Underwood.

absolutely destroyed by shell fire. I do not know exactly what to say would be the most interesting moment. One of the staff officers went up, and his balloon was burst at 16,000 feet up, and came down pretty fast. That was the quickest run down they ever had from shooting. On the other side, with General Buller at Colenso and up the Tugela River, Captain Phillips' section that he raised from the remains of the second section that had gone on, did some splendid work at Spion Kop and during the two or three succeeding days before Springfontein. At Spion Kop he located the position and made it out to be absolutely impregnable—that was probably why he came away. Then, on the other side, Captain Jones's section went up with Lord Methuen on Modder River, and his observations continued every day, and I do not think there was one single day that they were not absolutely of the greatest importance. And, finally, Lord Kitchener and Field-Marshal used balloons, and the information that was thus obtained enabled them to march on to Paardeberg. And again at Paardeberg the balloon was very useful; it enabled them to locate the whole position, and Lord Kitchener never gave them any chance to get out. I believe they would have got away in the night if they had not been located in that way. There has been a great deal of controversy about that, but we know what the balloon observation was, and we know the result. Major Blake's section went to Kimberley and on to Mafeking, and there the principal observation was taken at Fourteen Streams. They worked one balloon 13 days right off, just as it was with one load of gas, and by its means were enabled to prevent the Boers from relieving Fourteen Streams. Perhaps it was the most difficult thing they had to do the whole time. The balloon was magnificently successful in every way. To my mind that exploit of keeping the balloon in the air for 13 days under the tremendous ordeal it had to go through, was, perhaps, as good as any. Again at Paardeberg the balloon, I believe, worked five days right off and was shot in several places. On the Modder River, during the whole of the campaign, the Boers always shelled the balloons; in fact, whenever they saw them they directed their fire on to them. With regard to the difficulties in ballooning, there were some things in our favour and some against us. One of the great difficulties we had to encounter was the enormous heights



Balloon Corps ready to ascend for observation.—Lord Roberts' Army advancing on Pretoria.

[By kind permission of Messrs. Underwood and Underwood.

we went over. For instance, on the march to Pretoria we had hills 6,000 feet above the

Digitized by Google

sea, and, of course, to make an observation in these hills you had to go 1,500 feet or 2,000 feet up, so that the barometrical height was hard work on the buoyancy of the balloon, because the barometrical height then become 8,000 feet—the 6,000 feet altitude above the sea level and the 2,000 feet it was necessary to go over the hills—that was about all our balloons would do with the low barometer. Eight thousand feet is a pretty good height; I believe we have sent a captive balloon in this country 9,000 feet up, but that is quite the outside. As a rule we very seldom require to go more than two or three hundred feet above the hill we want to see over, so it was a very difficult thing to prop the ballons up sometimes. I know it was at Spion Kop; it was a very difficult thing to get that balloon up. It got up pretty well, and when it was up 5,000 feet, Captain Peters was shot in the cheek. Of course there are many details which interest me that perhaps would not interest you, so that I do not know quite what to say. Those pictures Mr. Bruce showed you were very good; they were taken on the march from Bloemfontein to Pretoria. This year has been marked by the number of balloons in active operation. Not only had we four sections in South Africa, but a section went to China under Colonel Macdonald, and another section which Major Trollope sent out under Mr. Speight went to the Jubilee in Australia to celebrate the anniversary. Of course the whole thing was a great strain to a certain extent on Major Trollope, who had to send everything out. As you are probably all aware we have to-day had news from the French experimental department for navigating balloons, of a very successful experiment, perhaps one of the most successful they have ever had. I do not know that there is anything further I can tell you which would be of general interest, but I shall be happy to answer any question anyone would like to ask.

The CHAIRMAN: I think, Ladies and Gentlemen, we are very much indebted to Col. Templer for having so kindly given us this brief address. I am sure it is more satisfactory to us to know that we have heard it from the lips of one who has been on the spot, and that we are not indebted to the paragraph of a newspaper which might be contradicted to-morrow. I now ask Mr. Bruce to read Mr. Lawrence Rotch's paper on The Chief Scientific Uses of Kites. Mr. Lawrence Rotch is the Director of the Blue Hill Observatory in the United States of America.



Snapshot of a Balloon Convoy crossing a Road in South Africa, taken by W. Maxwell, of the "Standard."

The Chief Scientific Uses of Kites.

By A. LAWRENCE ROTCH, Director of Blue Hill Observatory, U.S.A., and Member of the International Aeronautical Committee.

If we neglect the ancient legends regarding the employment of kites in China to communicate with the garrison of a besieged town and the carrying off of a golden ornament from a tower in Japan, the earliest use of kites seems to have been in 1749, when Dr.

Digitized by Google

Alex. Wilson of the University of Glasgow in this way lifted thermometers into the summer clouds. Curiously enough, this first application of kites to meteorological purposes has proved to be the most important use to which they have been put since. Two years later Dr. Benjamin Franklin, in Philadelphia, by means of a kite, proved the identity of electricity and lightning, these experiments being afterwards repeated by De Romas in France, by Beccaria in Italy, and by Cavallo in England. Early in the last century, interest in the kite for scientific purposes was revived, and Admiral Back obtained with it temperatures above Hudson's Straits, while in 1847 Mr. W. R. Birt proposed to obtain in the free air above Kew Observatory, observations of the various meteorological elements. In Philadelphia, about 1837, the Franklin Kite Club employed kites both for scientific experiment and for amusement. Still earlier, that is to say in 1823, an Englishman named Pocock dragged a carriage by kites, and even pretended that it outstripped the stage-coaches. He also proposed to employ kites in warfare to reconnoitre; and, in fact, with a great kite did lift a lady, seated in a chair beneath, to a height of several hundred feet. Kites to carry a line from a stranded ship to the shore, or *vice versâ*, were suggested as early as 1760, and since then a score of devices of this kind have been invented, including Sir George Nares' storm-kite in 1865. Quite recently such a use of kites has been advised, but it does not appear that any successful experiments to save life with kites have been carried out.

The advent of kites into modern science may be said to have been in 1883, when Mr. E. D. Archibald, of Tunbridge-Wells, showed how to get with them all kinds of meteorological data, and actually executed important measurements of wind-velocity at various elevations by means of anemometers fastened to the kite-wire, which he used in preference to string, as being lighter, smaller, and stronger. Mr. Archibald also took a photograph of the ground from a kite; and kite-photography was further developed by MM. Batut and Wenz in France. Ten years later Major Baden-Powell, the distinguished President of the Aeronautical Society, after much experimenting, evolved a flat kite without a tail which could be folded up for transportation and yet, when several of them were coupled together, sufficed to lift a man. He thus demonstrated that for army purposes kites might often advantageously supplant balloons.

However, for the application of the kite to all sorts of purposes—some of these ideas being pure newspaper fancies—we must go to the United States. Interest in the kite there was aroused by Mr. W. A. Eddy, a journalist, who, in 1892, introduced a tailless kite, resembling the Malay kite, with which he lifted thermometers, having already advocated a scheme of forecasting the temperature from such observations. In 1885—133 years after Franklin's experiment—Mr. Alex. McAdie, using an electrometer, repeated the experiment at my observatory on Blue Hill. In 1894 the first meteorological instrument, recording its indications graphically and continuously, was there lifted by means of Eddy kites, and since that time we have carried on systematically the work of exploring the air. With these meteorographs, as they are called, which inscribe minute by minute the changes of the principal meteorological elements, a record is made at the ground and simultaneously at the known height to which it is carried by the kites. The Malay form of kite was abandoned after the cellular kite invented in 1893 by Mr. L. Hargrave, of Sydney, became known. This type of kite, that is to say a kite having pairs of two or more superposed surfaces, is now altogether used by us. The surfaces opposed to the wind are curved like a bird's wing, and the vertical component of the wind is thereby increased. A kite having 70 square feet of lifting surface weighs about 11 lbs., and costs £10 or £12. Steel wire weighing 15 lbs. per mile, capable of resisting 300 lbs. pull, is used as a flying line to which the kites are attached at intervals, and a steam-winch is employed to haul them down. The meteorograph weighs about two pounds and records the barometric pressure, the temperature and humidity of the air, and the velocity of the wind. Several hundred flights have been made at Blue Hill

Digitized by Google

during the past five years, the highest last year exceeding three miles, and the average height of all the flights for the year being above a mile and a half. To appreciate the value of such records for the progress of meteorology, it may be well to call attention to the costly efforts made for many years past to get observations in the upper air from our mountain observatories. Although these have the advantage of yielding regular observations at a constant height, yet they do not represent the conditions of the free air at an equal height. To ascertain these conditions, balloons with and without observers have been extensively employed recently in Europe, but they offer these disadvantages: The balloon being in a relative calm is greatly heated by the sun and so the temperature readings are often too high. Moreover, balloons usually rise so rapidly that the instruments have not time to take on the state of the atmospheric strata through which they pass, but more important still is the fact that as a balloon drifts with the wind, and also along with the weather itself, the observations are not comparable with the observations that are being made at the starting point. Kites possess great superiority in these respects. As they remain nearly stationary with respect to the wind, the instruments are well ventilated, and owing to the small surface of the kite, no heat radiation can affect the thermometers. The observations are made at a known height, nearly over the station on the ground; and so, by making frequent ascents and descents, the conditions prevailing in this column of air at any time can be very accurately determined. Consequently, whenever there is wind and up to altitudes of three miles or more, kites present the best and cheapest means of ascertaining the meteorological conditions of the free air. Since the work at Blue Hill has become known, the use of the kite for meteorological purposes has become international. The United States Weather Bureau undertook during the summer of 1898 to obtain daily, at a mile above 17 stations, data with which to construct a weather map for forecasting, but, unfortunately, the light winds prevented the accomplishment of the project. Kites, however, are being employed, with success, by the meteorological bureaux of France, Germany and Russia, to gather information about the varying conditions of the free air; and, as already stated, this is the most important use of kites at present. It is probable that kites could be used advantageously in allied researches, such as the determination of the electric potential of the air, the intensity of solar radiation, and the collection of samples of air at different heights for analysis.

A few other purposes to which the kite has actually been put in the United States may be mentioned. First, men have been lifted by them on several occasions. In 1897, Lieutenant Wise, of the U. S. Army, having the same object in view as Major Baden-Powell in England, in 1897, with the aid of a cord and tackle succeeded in pulling himself up to a height of forty feet, sustained by several Hargrave kites, as Mr. Hargrave had already done in Australia. The same year Mr. C. H. Lamson, of Portland, Maine, using an immense kite, with superposed surfaces aggregating 600 square feet, between which he was seated, was lifted 50 feet or more above the ground. Mr. Lamson was able to change the angle of incidence to the wind while aloft, and in this way to make practical experiments on the kite as an aeroplane, from which it appears that the kite may render important services to the development of the flying machine. Lieutenant Wise has admitted the shortcomings of the kite for reconnoitring, namely that it requires wind, and, therefore, must be accessory to a captive balloon for military purposes. For the Navy, however, it is probable that a fast vessel in motion would always be able to create sufficient wind to raise a man-lifting kite; and for ease of handling and transportation on ship-board, kites are vastly superior to balloons. It may be possible on land and in a level country, for automobiles to raise such kites, but so far, to my knowledge, these vehicles have been employed solely to pursue kites that have broken away.

For photography, kites have been employed by Messrs. Eddy and Woglom, of New York, and they have secured tolerably good pictures of the ground from an extreme height of a few hundred feet by operating the shutter of the camera by a cord. It would appear that this offers a cheap and simple method of surveying, though so far no demonstration of its accuracy has been given. In order to obtain

Digitized by Google

photographs of the upper surfaces of clouds, which we can rarely see, the writer had constructed in Paris an automatic camera, to be hung below a kite, by which he hoped to get a series of such pictures. The exposures of the sensitive film are controlled by clockwork, so as to begin only after the apparatus shall have reached the desired altitude, and to continue at intervals that are arranged beforehand. The weight of the camera (6 lbs.) precludes its being lifted as high as our meteorographs.

Kites may readily be used, always provided there is wind, to signal visually. At night this can be done by lanterns, or, possibly, by an incandescent electric light, for which the current is transmitted through the retaining wire connected with a battery at the ground. Experiments were made two years ago at Blue Hill, looking to the employment of kites to raise the terminal wires in Marconi's space-telegraphy. While from a height of 100 feet electrical signals were transmitted 12 miles, yet the atmospheric electricity collected by longer wires precluded their use. Kites have carried telephone wires over inaccessible places, such as rivers, and no doubt they may serve a useful purpose in raising lines up precipices or over high buildings, in the manner proposed for communicating with wrecked vessels.

Other applications of the kite might be mentioned, but probably enough has been said to show that the kite, at the commencement of the twentieth century, is an important engine both from a scientific and practical standpoint.

The CHAIRMAN: I think we shall all agree that we ought to tender our cordial thanks to Mr. Lawrence Rotch, Director of Blue Hill Observatory, for this very interesting paper that he has sent us, on the "Chief Scientific Uses of Kites." (Cheers.) We will next ask Mr. Patrick Alexander to read his notes on Sounding the Air by Flying Machines controlled by Hertzian Waves (illustrated by working models); next, The Hofmann Flying Machine; then Rotary Kites, and other aerial apparatus.

Sounding the Air by Flying Machines controlled by Hertzian Waves.

BY PATRICK Y. ALEXANDER.

By arrangement balloons and kites are floated from Batheaston, Berlin, Paris, St. Petersburg, Moscow, Crackau, Vienna, Munich, Strassburg, on pre-arranged days carrying self-registering instruments which record pressure, temperature, and humidity of the atmosphere. The instruments are tested with standards before leaving, and all are furnished with notices in several languages praying that the instruments may be taken care of on landing, and returned at once to their starting place; the records are then sent to headquarters for comparison.

I have here two types of instruments, one for work at low altitudes and the other for high; this type having already done good work at 14 miles high.

As the instruments, balloons and kites are subject to various mishaps, it becomes necessary to devise means whereby they can be launched from the station, sound the atmosphere, and return to the station with the records in safety.

Fortunately, in the Hertzian Waves we have a power that lends itself to control the direction of small flying machines which are furnished with their own propelling power, upon which the instruments can be slung, and if the wind is not blowing too strong, the flying machines can sound the air within a radius of 20 miles both by day or night.

They are provided with a compass that indicates their course, and with apparatus that will give their direction and distance from the station, for it may be necessary to send away instruments in a fog or by night, when they would not be visible, to ascertain the thickness of a snow cloud, to test a cloud for atmospheric electricity, etc.

The instruments having been tested and fixed and the flying machine sent up, the compass, which, in connection with automatic gear, gives the course to the station; but if it is not correct, signals are sent to the machine which actuate apparatus that instantly guides the machine until she is steering the correct course.

Selenium being sensitive to light. I have also arrangements for steering by sensitive flames and also by peculiar sounds. The chief point I claim in this system is automatic apparatus to make regular contacts and a given number every revolution of a revolving arm.

It is hoped these machines can be used for various purposes, for instance, carrying messages, exploring, and camera work, for relays, land and marine, can be arranged to control the flight of the machines, even if they are going at the rate of upwards of 1,000 miles an hour.

Digitized by Google

Hofman Flying Machine.

This machine is upon the aeroplane principle, driven by screws. There are two screws, or rather one double screw, which gives a turning movement to the machine; but this is equalised by automatic apparatus which balances the affair.



The Hofman Flying Machine.

The machine is provided with legs; the arrangement is very good indeed, and enables the machine to "take off" better than running up at an incline from the ground, and on landing receives a gradual retardation or cushioning effect.

Rotary Kites.

Hitherto, kites have generally been constructed for simply riding on the wind; if the kites rotate a better lifting effect is anticipated, by screws turned round by the wind.

At the conclusion of his paper Mr. Alexander showed apparatus illustrating the behaviour of screws rotating in a horizontal plane when exposed to currents of air, also Mr. Buchanan's transverse grip propeller. This differed from the ordinary screw in as much as the blades have grooves, suitably arranged which appear to grip the air better than a plane surface.

Digitized by Google

Another exhibit was intermittent jets or currents for propulsion or reaction. These are more economical than constant currents, which seem to drive through the air without producing much reaction.

The CHAIRMAN: I am sure we are all much indebted to Mr. Alexander for the great trouble he has taken, and for the interesting experiments he has made. I have asked Mr. Alexander to allow me to examine this fan, and you will observe a number of ridges here, which as I understand him are to grip the air. Well, some time ago, I remember being informed that it had been ascertained by means of the microscope that the wings of some insects and some flies are fashioned very much on this principle; so that you see if this were turned round in the air, the air would not slip away as it would with a simple plane, but it would go by this and would therefore turn it round very much faster than it would otherwise.

Balloon Photography at Great Altitudes.

BY PERCIVAL SPENCER.

One of the most useful accessories of the modern aeronaut is the photographic camera, for, by its use, he is enabled to place before the world reproductions—meagre and inadequate it must be confessed—of the extended panoramic views and glorious visions which are ever before his lofty gaze. The Frena camera which I carry, contains forty films on celluloid, packed flat like a pack of cards, and I am enabled to expose and develop any number of these as circumstances require. The advantages of films over glass plates for balloon work are obvious, the saving of weight, the absence of danger of breakages at a breezy descent, and the very large extra number of pictures which may be taken, are all in their favour.

In photographing views on the ground, the aeronaut has to use his discretion in the selection of the subject; and, moreover, pay attention to the foreground, the middle distance, and the far distance, in order to secure a pleasing result.

To one uninitiated in photographic work, an open position with undulating hills and a view as far as the eye can reach might appear a splendid subject for a photograph, but the experienced picture-maker would avoid such a view, and select one in which the foreground and middle distance contained some object of interest.

The balloon photographer, however, has no such discretion. As soon as the balloon leaves the earth the picture becomes a distance one; he can snap one or two views at the very start, and afterwards he has distance only, the grandest view it is possible for mortal eye to see, the horizon extending for twenty miles or more, but everything in diminutive proportions.

He becomes a student of distance photography only, he studies the light and shade, and looks out for interesting features to include in his pictures, and his object is to secure interesting "bird's-eye views."

With this object in view, the most important consideration is the altitude and the clearness of the body of atmosphere through which the photograph is to be taken.

In a misty state of air one may expose a picture at a low altitude, a few hundred feet, and obtain a result, whilst at a few thousand feet the result on the film would be absolutely nil, the reason being that at the small height the picture itself reflects sufficient active light to produce the impression, whilst at the great height the mist intervening reflects the light and is photographed instead of the view on the earth. To the human eye the view may be possible, but to the eye of the camera all is blank.

In a clear air photographs are practicable as high as the balloon can ascend, and it only becomes a question as to whether any suitable subject for the purpose lies beneath. For instance, in a balloon trip across the English Channel, one may be for hours at a height of thousands of feet in sight only of the sea beneath, a very fine situation undoubtedly, and one which gives ample opportunity of speculative considerations. Where are the vast fleets of steamers which ply continually? where are the ocean-going vessels? where even the humble fishing craft? Nothing to be seen but the deserted waters for the whole range of view. Even if an occasional boat passes in sight it forms no subject for such a distant photograph, but when one crosses the shore and passes over dockyards, piers, buildings and rivers, there certainly are the subjects for snapshots from the eagle eye of the Frena. For such a subject one gives a rapid exposure, say 1-40th or 1-80th of a second, and uses a small stop to the lense, say F/32. The exact details grow on one instinctively and vary with the time of day and of year, and in the after process of developing the latent picture one gains experience for future work. To practically demonstrate this work I now show lantern slides made from my negatives.

Digitized by Google

Slides were shown of:—

1 and 2. The balloon ready to start from the Crystal Palace Grounds.

3, 4, 5, 6, 7, 8, 9. The Crystal Palace and Grounds, taken from the balloon car at varying heights, from 250 feet to 1,000 feet.

10. Charlville Circus and Sydenham, from a height of 1,000 feet.

11. Lower Sydenham and Gas Works, from 1,500 feet.

12. Honor Oak Station and Cemetery and District, from 2,000 feet.

13. The Thames and Greenwich, from 1,500 feet.

14. Greenwich Hospital, from 1,000 feet.

15. Woolwich and the Entrance to the Arsenal, from 3,000 feet.

16, 17, 18, 19. Views of Hastings and St. Leonards, when passing out to sea at a height of 9,000 feet.

20. An immense crowd of spectators at Wolverhampton, from 250 feet.

21. The City of York, with buildings, Old Wall, Bootham Bar, and Old Minster, from 1,000 feet.

22. Boulogne and Harbour, from 5,000 feet.

23. Dover Harbour, from 2,000 feet.

24. The fortified French town of Gravelines, from 5,000 feet.

In conclusion, I think these views have shown the truth of my early remarks as to the utility of the camera as an adjunct for the balloonist. The modern improvements in cameras and photographic work render the process certain and simple, and the aeronaut photographer therefore has much greater surety now than was possible but a few years since. The views which are secured, too, often show details and points of interest which may escape notice when taking the fleeting view which one is enabled to get with the human eye. These photographs, under many circumstances, may prove of use to the surveyor and military man, and all the laws in the world cannot prevent the passage in the air, thousands of feet aloft, of a balloonist with his camera, although he may be over most important strategic positions and fortifications.

It is, however, mostly as a means of increasing the interest in balloon trips and obtaining interesting records of enjoyable balloon voyages, that I hope to see my passengers, friends, and members of this Society who accompany me and my brothers aloft, armed with photographic cameras, so that they may obtain mementoes of what all balloonists know to be the most delightful experience which is possible for mankind—to soar aloft into the air in which he lives and breathes.

The CHAIRMAN: I am sure, ladies and gentlemen, that we are not only much indebted to Mr. Percival Spencer for his interesting remarks, but also it has been a great treat to us and a great privilege to see these beautiful photographs, which I venture to think very few of us have had the opportunity of seeing before. Our programme for this evening is now completed, and I have only just a few words to add. We have all heard and read recently of the ascents made in France by M. Santos Dumont, and it has been reported in so many papers that no doubt you have read the particulars. I wish just to add this: whilst we may give M. Santos Dumont every credit for his perseverance and ingenuity, and hope that he will obtain the prize of 100,000 francs (£4,000), we know that it is only in the case of very calm weather that such a feat as he has performed is possible, etc.

We may say that our pleasant entertainment is concluded, and we have to thank you very much for your kind attention and for your presence here.

Mr. E. P. FROST: Ladies and Gentlemen,—I am sure we all feel deeply indebted to the gentleman who has so ably officiated in the Chair. I would, therefore, propose a vote of thanks to Major Roberts.

Col. TEMPLER: I beg to second that.

The vote of thanks having been carried by acclamation,

The CHAIRMAN said: I beg to thank you, ladies and gentlemen, for your kind vote of thanks.

The proceedings then terminated.

M. Santos Dumont's Navigable Balloon.

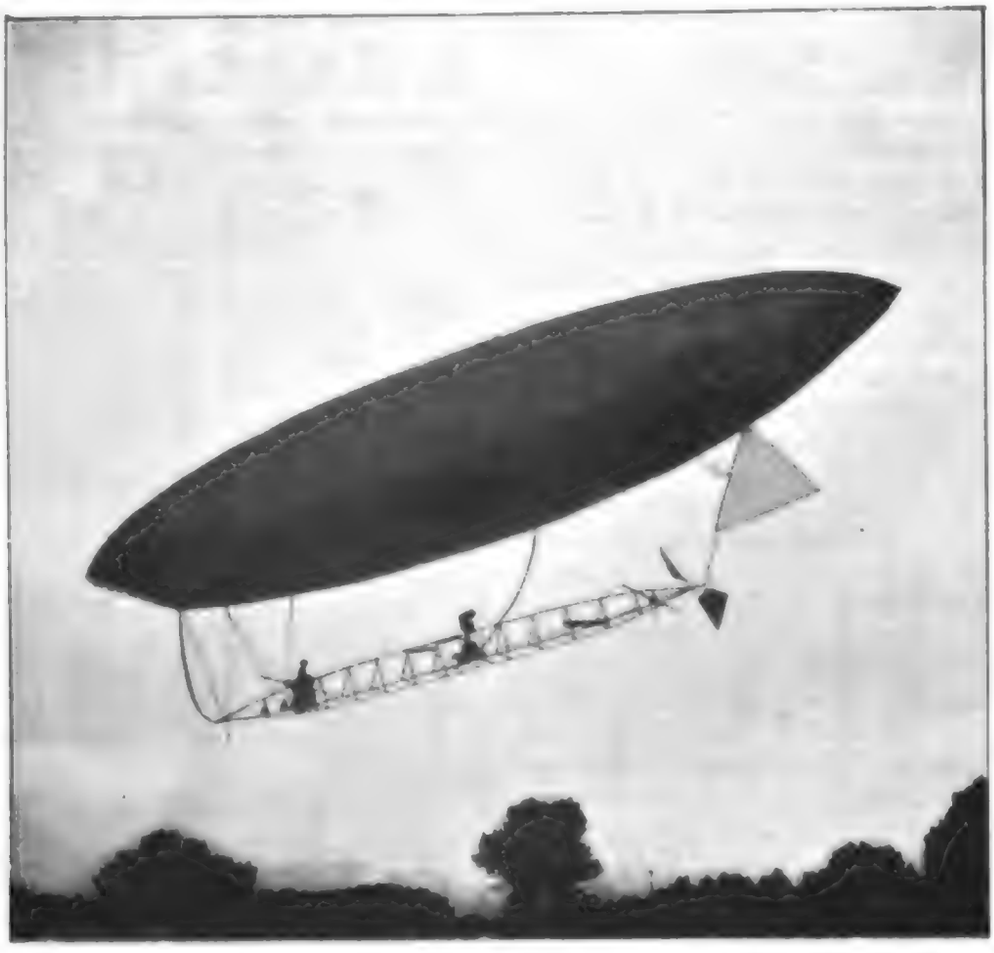
If M. Santos Dumont has not yet contrived to navigate his airship against a wind of any great dimensions, he has by pluck, determination and perseverance, succeeded in drawing the attention of the whole world to aerial navigation, and stimulating a greater interest in the problem than has ever before been aroused. Previous inventors of navigable balloons, though they have spent thousands on their constructions and have received sufficient encouragement in the success of their initial experiments to justify further

Digitized by Google

expenditure of their time and money, have suddenly stopped short in their investigations, some for want of further funds, others, no doubt, for want of the rare but necessary virtue of perseverance. Its possession by M. Santos Dumont is shown by his resolution to use failures as stepping stones to success. To him hitches and accidents have hitherto been pregnant with suggestion for further improvement. During the past four years he has evolved no less than six airships, each succeeding type embodying steps of progress evolved from practical experiment. The whole scientific world must have congratulated the young Brazilian aeronaut on his escape from injury on the occasion of the three accidents which have recently befallen his airship; but while it is confidently hoped by all aerial experts that in the interests of aeronautics he will continue his experiments, it will be the wish of his friends that he will allow prudence to accompany bravery and perseverance, and not unduly risk a life that promises to be of such value to the cause of aeronautics.

The details of M. Santos Dumont's experiments and accidents have been very ably treated in articles in the *Times* and other daily papers, and especially graphically in a series of articles in the *New York Herald*, including some accounts written by M. E. Aimé, and to which we would specially refer our readers.

Concerning the experiments in July last, M. de Fonvielle, the late President of the French Aeronautical Society, has contributed a communication to the Aeronautical Society of Great Britain.



M. Santos Dumont's Navigable Balloon.

[By kind permission of the "Illustrated Mail."

COMMUNICATION BY M. DE FONVIELLE.

"I think it is my duty to write on behalf of the Aeronautical Society my impression of this grand experiment. The results obtained must be attributed to several causes which it is important to relate singly. The elongated balloon has invariably kept its form because it is connected with a ballonet inflated automatically by a ventilator worked by the engine. The envelope is connected with the

Digitized by Google

frame by an immense number of vertical steel wires which forms a solid mass travelling in the air. The immense helix is four metres in diameter, and is worked by an engine of 16-horse power. A powerful system of ventilation prevents the over-heating of the engine. In itself, the rudder has nothing worthy of notice, and could be replaced by any lateral sail or resistance.

The intelligent and happy use of the ventilator is deserving of praise. It is quite a new feature in the experiments, and is opening a fruitful way to the aerial art. It dispenses with the cumbersome and heavy Zeppelin aluminium wire cage. The working of the apparatus for putting the engine into operation was imperfect, and to its faulty condition may be attributed the final collapse. The petroleum engine with its four cylinders is also too complex and too easily put out of order. But these faults are after all trivial, and do not diminish the value of the teachings of the new construction as a whole. It must be said that M. Dumont has paved the way of the clouds and given wings to the petroleum engine. The new dirigeable balloon is not a perfect one, but it has done a great deal more with its 550 cubic meters of hydrogen than Count Zeppelin's with its 11,000."

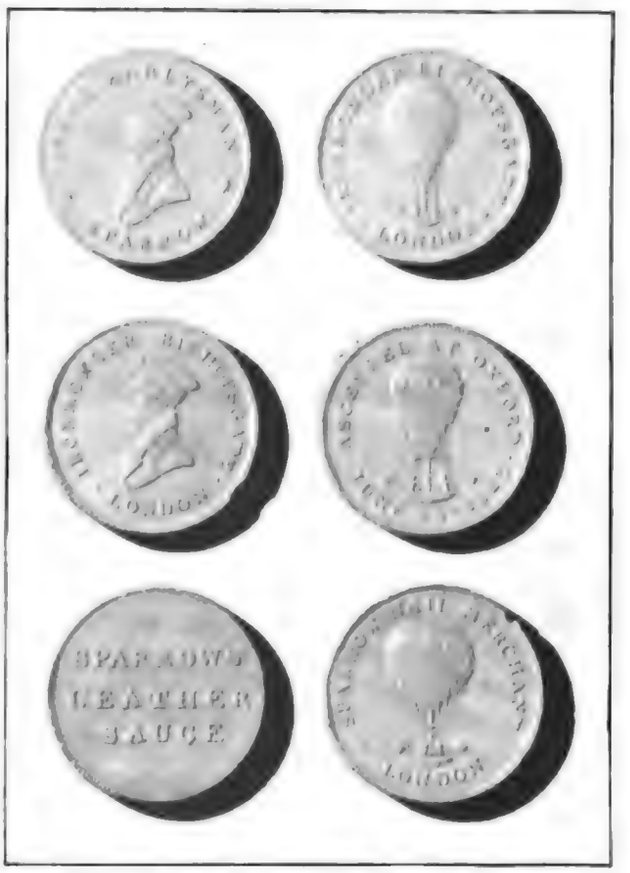
Since M. de Fonvielle wrote this communication three accidents have befallen M. Santos Dumont, the news of the last coming to hand while the writer is preparing this article.

The accident of M. Santos Dumont on August 8th, when he fell a distance of no less than 2,000 feet on to the roof of the Trocadéro Hotel, shows the importance of the cigar-shaped balloon keeping its envelope in a rigid condition. On this occasion the apparatus which supplied the ballonet with air for the purpose of maintaining its rigidity did not act, and experts may ask whether this system of pumping air into an inner balloon for the purpose of maintaining the rigidity is sufficiently simple to ensure its maintenance, and whether there was not reason in the provision by Count Zeppelin of a rigid light framework? Possibly the accidents sustained by the intrepid Brazilian aeronaut may have led M. de Fonvielle to modify his views on this point; and it is hoped he will send a further communication for the next number of the "Aeronautical Journal" concerning the latter experiments. From the accident of Sept. 6th it would appear that M. Santos Dumont's No. VI. balloon did not retain the hydrogen as well as could be desired; and this accident emphasizes the want of a gas-proof varnish. Now that there is activity in balloon engineering, is there no chemist that will give this urgent aeronautical need his attention. It is surely within the powers of chemistry to improve upon the faulty varnishes which are used in balloon manufacture. It was this want which, doubtless, first led the British Government balloon experts to employ goldbeaters' skin for the balloon envelope. The expense of goldbeaters' skin, will, however, always be a hindrance to its general adoption.

It is frequently asked how far M. Santos Dumont has, by his experiments, advanced the art of aerial navigation. It does not appear that he has navigated his balloon against more than very light winds; but in his machinery he has shown such attention to detail that it may reasonably be expected that if he continues to increase his motive power he will ere long exceed past performances.

The Sparrow Balloon Coin.

We are indebted to the courtesy of Miss Agness Buttress and the Keeper of Coins at the British Museum for the representation of the Sparrow Balloon Coin herewith presented.



The Sparrow Balloon Coin.

(Reproduced by kind permission of the Keeper of the Coin Department, British Museum.)

Digitized by Google

Miss Agness Buttress writes as follows: "About the end of last May I was digging in my garden to plant a shrub, and turned up what I thought at first was the shank of an old button; but being somewhat observant by nature, I rubbed the earth off and examined the coin under a glass; I then polished it a little with metal paste, thinking it was silver, and could read the words. The terrace I reside in is situated at the base of Highgate Hill, North London, and the houses have been built more than 60 years."

The writer of this letter was kind enough to lend the Honorary Secretary of the Aeronautical Society the coin described above, and which is represented by Nos. 3 and 4 in the illustration. As will be seen, on one side of the coin is the representation of a pear-shaped balloon with two passengers in the car and bearing on it the word "Sparrow." Round the engraving of the balloon are the words "Ascended at Oxford, June 23rd, 1823." On the other side is the representation of a man in an old-fashioned coat and wearing a cap with peak. Round this are the words "Ironmonger, Bishopsgate, London."

In the attempt to throw light on the balloon ascent made by this enterprising ironmonger, the editor of this journal paid a visit to the Keeper of Coins at the British Museum, and found that the coin department of the Museum not only possessed a sample of the coin found by Miss Agness Buttress in her garden, but also others which had been evidently struck by the ironmonger aeronaut, and which bore somewhat dissimilar impressions. 1 and 3 represent the impressions on each side of one; of these, 1 gives the full name of the ironmonger—Isaac Earlyman Sparrow; 2 shows another representation of the balloon, slightly differing from No. 4. Nos. 5 and 6 show that Mr. Sparrow evidently used these coins as means of advertisement, for on one side of this coin appear the words "Sparrow's Leather Sauce," while on the other, round the balloon, are the words, "Sparrow, nail merchant, London." The balloon is, again, of a different shape, being more spherical in this case. These three representations of the balloon would seem in each case to be from the pen of different draughtsmen. In order that these various specimens should be represented in the "Aeronautical Journal," the Keeper of Coins in the British Museum very kindly ordered plaster casts to be made of each specimen, and gave permission for their reproduction.

In further pursuit of information concerning the ascent of Mr. Sparrow, the editor of this journal paid a visit to Oxford and consulted the pages of "Jackson's Oxford Journal" for 1823. It may be remarked that this latter journal is one of the oldest-established newspapers in the kingdom, this being the one hundred and forty-ninth year of its issue.

From the search, it was ascertained that this balloon ascent was really made on June 13th, 1823, from the Oxford Gas Works in Commemoration week, and that Mr. Sparrow accompanied the famous aeronaut, Mr. Green, to whom the balloon belonged. As the date on the coin found by Miss Agness Buttress is June 23rd, 1823, it would seem that this date is the one on which the coin was struck.

Permission has been obtained for quoting the following extracts from "Jackson's Oxford Journal," giving details concerning his ascent.

Extract from "Jackson's Oxford Journal," June 14th, 1823:—

"The entertainment carved out for yesterday was the ascent of Mr. Green in his balloon; and so powerfully attractive was the spectacle that from an early hour every road leading to Oxford was an unbroken stream of pedestrians, horsemen, and carriages of all constructions; and as the morning advanced, the whole population of the neighbourhood seemed to have emptied itself into our streets.

"The ascent of the balloon was delayed for more than two hours, from an accident that happened to one of the poles at the commencement of the arrangements; but about half-past two, the inflation being completed, Mr. Green mounted the car accompanied by a gentleman of the name of Sparrow, of London. Nothing could exceed the intrepid self-possession of both of them. The beautiful and majestic vehicle rose with extreme slowness, and Mr. Green immediately threw out part of his ballast, but not with entire effect, for the ascent was still so gradual, that part of the net-work encircling the balloon caught the corner of the chimney of one of the buildings of the gas works, and the jerk given in consequence to the whole apparatus of the balloon was so strong that the car was very nearly upset, and at the same moment a sensation of horror came across the feelings of everyone of the many thousands who were near enough to observe what had taken place. Fortunately, however, both the aeronauts kept their seats; and instantly Mr. Green's companion with consummate address waved his flag gaily and frequently in token that the car had recovered its balance, and that all danger on that score had passed away. The balloon took a south-easterly direction, and at

Digitized by Google

a quarter before six the intrepid aeronauts descended in the park of Lady Stapleton, at Rothafield Grays, near Henley, having been up three hours. The descent was accomplished without any accident to the voyagers and the balloon, but it appears not without considerable difficulty. At twelve o'clock last night Mr. Green and his companion arrived in the city with the balloon in perfect safety."

Extract from Jackson's Oxford Journal, June 21st, 1823, being the narrative of Mr. Sparrow, the young gentleman who accompanied Mr. Green on his aerial voyage from Oxford on June 14th, 1823.

"On rising from the ground it appeared as if we were impelled upwards, not unlike the feeling excited by the action of a swing. The concussion when the car struck the chimney of the gas works was electric, and gave the car a vertical movement. On clearing this obstruction we took an oblique direction inclining to S.W., when a light current of air springing up we again changed for due east, and rose perpendicularly and rapid from the quantity of ballast we had thrown out to clear the gas works. It is not in the power of language to express the gratification the aeronaut experienced on viewing the expanse about him into which he was gradually and almost imperceptibly rising. At about half a mile from the earth, a variety of currents were encountered, which produced a retrograde and sometimes angular motion. To avoid any sensation of fear from looking too suddenly down on the objects beneath, the young aeronaut accustomed himself to the view by gradually taking the more distant object first, and in a short time he was able to look with the greatest confidence on the surface of the earth, which at that time presented the most beautiful variety of colours resembling a mosaic pavement heightened by the sun's reflection. Around them the clouds appeared in oceans of snow, beneath the splendid carpet of Nature spread forth her gay varieties over an immeasurable expanse. The accident at starting had injured the barometer, but not so as to prevent their calculating the heights. On leaving the earth, the mercury stood at 29 inches 7-10ths. At the greatest altitude to which they rose it was at 21 inches 3-10ths. From this they calculate they were above two miles from the surface of the earth. The thermometer fluctuated greatly, the lowest point was 55, the highest 70. As the barometer would not answer to the descent they had recourse to an expedient by placing one of the flags over the side of the car, and observing the action of the air upon it; by this means they ascertained when they were descending or rising. When they had been in the air one hour and a half, the cap of the neck of the balloon came off, and as they were compelled to stand up and tie a silk handkerchief round by which means they succeeded in preventing the too rapid escape of the gas, nothing material occurred for the next hour and a half until they began to descend. Mr. Green conceived they hovered over Nettlebed Heath where the woods are unusually thick. They had now little ballast left, and, therefore, no choice of selecting a more favourable spot; they continued to descend rapidly, and at about a thousand feet from the earth Mr. Green gave his companion instructions to throw out the cushions and cling fast to the hoop from which the car was suspended to the balloon. They had scarcely done so before they experienced a most violent concussion from the machine striking the earth and rebounding a height of 50 feet. It then rose and passed a few yards, when, on a second descent and shock, Mr. Sparrow was thrown out, and the balloon thus lightened, rose again with Mr. Green. At about a distance of 150 yards, Mr. Sparrow having recovered from the shock and caught hold of the ropes, the netting and car became entangled in the tops of some very high trees. In this perilous situation immediate assistance was offered by the labourers in Lady Stapleton's Park, where they had first fallen upon a rising ground, and within 300 yards from the Mansion House. Stapleton Park is two miles from Henley and 22 from Oxford. The balloon was, by the exertion of a dozen strong fellows, soon secured, and Mr. Green descended down the rope to terra firma. The car was dashed to pieces by the violence of the shock. Lady Stapleton instantly sent and invited the aeronauts to partake of some refreshments, and offered them every assistance in securing and conveying the balloon to Oxford, where they arrived about 12 o'clock on Friday night.

Possibly some of the readers of the Aeronautical Journal may be able to send other particulars of the aeronautical career of Mr. Sparrow. From the fact that each of the coins are differently engraved and that the shape of the balloon is different on each, it may reasonably be assumed that they each memorialize different ascents.

Digitized by Google

Reviews.

Aerial Navigation—Balloons and Flying Machines from an engineering standpoint, by Octave Chanute. Cassier's Magazine (June, 1901), London.

At the present moment when the efforts of M. Santos Dumont have attracted so much general attention to aerial navigation, Mr. Octave Chanute's excellent summary of progress in aerial engineering in Cassier's Magazine will be especially welcome to that section of the public who wish to obtain a bird's-eye view of the subject.

In the article he very clearly treats of the performances of the navigable balloons and flying machines that have as yet been devised.

Concerning the experiments of Count Zeppelin, Mr. Chanute is of opinion that he would have obtained better results if he had imitated the fusiform shape of the French balloon of 1885. "The resistance of this was given by Renard as $R = 0.01685\ D^2\ V^2$ in metric units, and amounts to $R = 0.0006876\ D^2\ V^2$ in British units, in which D is the diameter of the balloon in feet; V the speed in miles per hour; and R the resulting resistance in pounds. This amounts to 18 per cent. of that of a thin plane equal to the largest cross-section in area.

Zeppelin having obtained a speed of 18 miles an hour, as stated by himself, the resistance of his ship is

$$\frac{32 \text{ H.P.} \times 375}{18} = 667 \text{ pounds.}$$

which is 34 per cent. of that of a disc 39 feet in diameter with a pressure of 1.62 pounds to the square foot; this pressure being that due to the speed. The equation for his airship is therefore, $R = 0001353\ D^2\ V^2$ in British units, but he might have attained about 22 miles an hour had his shape been the same as that of Renard; and still more had it been that of a fish, say a salmon."

The recent experiments of M. Santos Dumont have taken place since Mr. Chanute's article was written; therefore, we have not yet Mr. Chanute's opinion of these; he merely mentions M. Santos Dumont's earlier experiments without criticism.

Speaking of the possibilities of navigable balloons in the future, he points out that "the size must be great, even to the verge of impracticability, the form must be that of least resistance, and the length should not be more than ten times the diameter in order to ensure stability. Moreover, the propeller must be effective and preferably at the front, and the motor, including its supplies, should develop great power in proportion to its weight. If all these conditions be observed, the French experts allow that the ultimate speed may attain 44 miles an hour in the distant future. This is about the speed with which motor-driven flying machines will begin.

Regarding flying machines, Mr. Chanute considers that the best that has been done has been to sustain from 27 to 55 pounds per horse power by impact upon the air. "Gliding machines, it is true, using gravity as a motive power, show 89 to 110 pounds sustained per horse power, but these figures must be considerably reduced when an artificial motor is substituted in order to cover the inevitable mechanical losses in the machinery and in the propeller. Much has been done within the past decade towards reducing the weight of motors. Steam engines have been produced weighing but 10 pounds per horse power, and the latest gasoline motor, that of Buchet, is said to weigh only 12½ pounds per H.P.; but much remains to be done to render machines working so nearly up to the limit of endurance absolutely reliable and safe in the air. It now seems probable that the successful aerial motor will be some form of gasoline engine using air instead of water as a working fluid, and thus saving weight."

One of the most important points about flying machines is, in Mr. Chanute's opinion, the maintenance of equilibrium. On this subject he is, perhaps, the greatest living authority, as he has devoted so much attention to the subject of soaring machines. After the disastrous termination of the ascents of both Lilienthal and Pilcher, it is satisfactory to hear that Mr. Chanute has had about one thousand slides made by assistants, with two different types (5 machines) without the slightest accident.

Concerning the methods of obtaining equilibrium he says, "The underlying principle of maintaining equilibrium in the air is that the centre of pressure upon the sustaining surfaces shall at all times be upon the same vertical lines as the centre of gravity, due to the weight of the apparatus. In calm air this is fairly secured, but in a wind the centre of pressure is constantly shifted by the turmoils of the air, for it advances or recedes with the diminution or increase of the angle of incidence. There are several ways of counteracting this difficulty. The centre of gravity may be shifted back or forward to coincide again with the vertical line passing through the new centre of pressure; this is the method employed by Lilienthal and by

Digitized by Google

Pilcher, which they applied by shifting the position of their personal weight. Or the centre of pressure may be brought back into a vertical line with a fixed centre of gravity either by changing the angle of incidence, or by shifting the surfaces themselves. These latter are the methods which have been experimented upon by the writer in three different ways:—

"1. Affixing a horizontal tail (the Penaud tail) at an angle to the supporting surfaces. This catches the air on its upper or lower surface, and shifts the angle of incidence of the wings, and, consequently, the centre of pressure.

"2. Pivoting the wings at their roots so as to move horizontally. These are arranged so that the impact of the air shall bring them back into the proper position.

"3. Pivoting the surfaces so as to rock vertically. This is arranged so that the impinging air shall automatically shift the angle of incidence, and, therefore, the centre of pressure.

"The third arrangement is believed to be the best, but one cannot be sure, inasmuch as all the adjustments above indicated are most delicate. Simple as the principles seem to be, it requires years of experiment to apply them properly. The positions of the pivots, the strength and adjustments of restraining springs, and the best position for the centre of gravity involve thousands of cut-and-try experiments, first with models and then with full-sized gliding machines carrying a man."

Meetings of the Permanent International Aeronautical Commission.

TRANSLATED BY H. A. B.

At this meeting of the Permanent International Aeronautical Commission, a report, by M. Hervé, was read on the method of publishing the work of the Committee; also a statement by Chevalier Pesce on the presentation of the reports of the delegates of the Permanent Commission at the late International Maritime Congress at Monaco. The Commission adopted Colonel Renard's proposal to approach the Life-Saving Societies with the object of realising its proposals for maritime aerial life-saving apparatus, and of starting preliminary experiments. The Commission calls upon its delegates at the Monaco Congress to complete their work by a practical assent.

Owing to incomplete accounts of its last communication, the Committee considers it advisable to again point out the permanently advantageous nature of the facilities it has obtained for the free return carriage of a balloon fallen in a strange country, by the presentation of a certificate of origin guaranteed by the maker and visé once for all by the commission.

June 27.

At this sitting, Naval Lieutenant Sapissier, on behalf of M. Ch. Ed. Guillaume, President of the Sub-Committee of "Balloon Bearings," in relating the work of the Sub-Committee, summed up a memorandum from M. Favé, hydrographic engineer-in-chief, on a series of magnetic and astronomical observations from which he deduces a method of taking bearings which promises safety to aeronauts from their principal danger, that of drifting unbeknown to sea when at great altitudes above the clouds.

To enable aeronauts to recognise their whereabouts when approaching the earth, the sub-commission, at the suggestion of Comte de la Valette, is considering the bringing out of a species of dictionary, whose data will be figure-types characteristic of the aerial aspect of the earth's surface. This work will be linked later on to the aeronautical charts which the sub-committee will subsequently prepare.

NOTES.

Dr. Berson's Recent High Ascent.—On July 31st Dr. Berson and Dr. Süring made an ascent from Berlin, and reached a height of over 34,400 ft., thus beating the previous registered records of the height reached in a balloon, though, as in the case of the ascent of Glaisher and Coxwell in 1862, the extreme height attained is not registered as both aeronauts lost consciousness. The minimum temperature registered was minus 40 degrees centigrade. The *Daily Mail* of August 3rd gives some very interesting details concerning the ascent. At 800 feet below the highest point registered, the aeronauts became unconscious and remained in this state three-quarters of an hour. At a height

Digitized by Google

of 3,280 feet the cries of geese and cattle were still heard, and the sound of a railway engine was audible up to 20,000 feet. After this point there was perfect silence. Freezing point was reached at a height of 12,400 feet, at 20,000 feet furs were put on, and at 30,000 feet the aeronauts resorted to inhalation of pure oxygen. Concerning the inhalation of oxygen there is probably some reason in the opinion of M. de Fonvielle, given in his address to the Aeronautical Society of Great Britain in April last when he urged the importance of inhaling pure oxygen at the first feelings of inconvenience in high ascents, and not waiting until the verge of insensibility. Possibly, if Dr. Berson and his companion, in the recent ascent, had commenced the inhalation sooner, they would not have become unconscious.

The Systematic Exploration of the Atmosphere at Sea by Means of Kites.—Hitherto, the one disadvantage connected with meteorological observations by means of kites has been the impossibility of working them in winds less than 12 miles per hour. Mr. Lawrence Rotch has lately carried out experiments with kites at sea, which have proved the possibility of flying them from board a vessel in calm weather. The method not only permits kites to be flown in anti-cyclonic conditions, but enables data to be obtained a mile or two above the oceans where no observations have been possible hitherto. Mr. Lawrence Rotch brought this important step in the progress of scientific kite flying before the last meeting of the British Association at Glasgow; and, owing to his courtesy, we are enabled to quote the following extract from the abstract of his paper.

The method consists in installing the kites and apparatus on board a steamship, which, when travelling through calm air at a speed of 10 or 12 knots per hour, enables the kites and instruments to be raised to the height that could be reached in the most favourable wind. Should the wind be too strong, its force may be moderated by steaming with it. In this way the kites can be flown at all times and in these equatorial regions where a knowledge of the conditions of the upper atmosphere is needed to complete our theories of the atmospheric circulation.

The use of kites to the best advantage requires a vessel that can be manœuvred at will; and, therefore, experiments were made in Massachusetts Bay on a tug having a maximum speed of 10 miles an hour. Although the wind blew only 6 to 10 miles an hour, and at no time was strong enough to lift the kites, yet by steaming towards it within 45° of its mean direction, the meteorograph was raised to a height of half a mile. The ease with which the kites were launched and the steadiness with which they flew in the uniform artificial wind were noticeable. A trial of the kites was next made upon a passenger steamer crossing the North Atlantic, in order to ascertain whether it was possible to obtain in this way meteorological data frequently during the voyage. Flights were made on five days, when, although the winds accompanying an anti-cyclone were too light to lift the kites, the artificial wind, caused by the eastward motion of the vessel at a speed of 15 knots, sufficed to carry the kites and meteorograph to a maximum height of one-third of a mile. Had it been possible to alter the course of the vessel the kites could have been flown every day. The kite records obtained in this anti-cyclone, in connection with similar ones on deck, show abnormal changes of temperature with altitude above the ocean, great fluctuations in relative humidity, and slight variations in wind velocity. A series of such flights on successive voyages would disclose any difference in the vertical distribution of the meteorological elements above the ocean as compared with that over the land, and in weather conditions like the above, would furnish data for the upper air that cannot be obtained with kites at a fixed station.

New Airships.—Besides the large airship which is to be constructed by Dr. Barton, there are two patterns of airships being constructed in this country which are both destined to compete for the coveted Deutsch prize.

1. Mr. F. Buchanan's airship.—In the *Graphic* of Sept. 14th will be found a picture of this airship and some details as to its construction. It is shaped like a fish with the exception of a bird's head in front. Its length is to be from 80 to 100 feet. A special novel feature is that the cabin and the propellers will be inside the balloon, which is divided into an upper and lower portion. The upper portion is to be filled with gas and will contain 45,000 feet, just sufficient to balance the weight of the apparatus, divided into three compartments. The fore and aft compartments will be used simply as air chambers to fill out the shape of the fish balloon. The central chamber will be the cabin, engine-house, etc. This will be provided with a door

Digitized by Google

at the side and portholes giving a view fore and aft; and from its sides will project the two propellers. Each blade of the propellers will be about five feet long by three in width, and a very important feature of the propellers is that they are to be covered with minute grooves running diagonally outwards. These grooves are said to increase the grip of the propellers on the air, and to give a much greater thrust. Like the other recently-constructed airship oil motors will supply the power.

2. Mr. W. Beedle's Airship.—In *Black and White* for Sept. 14th will be found a picture of this aerial craft. This is to be 100 feet long and 16 feet in diameter. It is constructed to carry two men, and will be driven by a 28-h.p. air-cooled motor with four cylinders. The balloon is to contain five gas compartments and is encircled with six aluminium hoops being further strengthened by three horizontal lengths of steel tubing each measuring 80 feet. The tubing will impart rigidity to the gas holder and carry fans, motor, and car. The balloon has a capacity of 18,000 cubic feet, and when filled with hydrogen gas will lift a dead weight of 1,260 lbs. Besides the propellers for controlling the horizontal motion there is one for controlling the vertical movements without loss of gas or ballast. The completion of these two airships and their trials will certainly be awaited with no little interest.

The Balloon Voyage Across the Channel from the French Side.— On September 21st, M. George Latruffe, the French aeronaut, succeeded in crossing the Channel from the French side. He ascended at Dunkirk at 1.45 on Saturday in the balloon La Patrie. He was carried to the north-east coast of Essex, whence he was driven back to the mouth of the Thames. He again went north, and not far from Burnham-on-Crouch, his jib broke away. He then made the descent about half a mile from Southminster Railway Station.

During this voyage it appears that at one time the balloon descended so near the water that the aeronaut was able to speak to a passing steamer; but apparently no one on board could speak French, and so no reply back was received.

The Dust Floating above London.— The Rev. J. M. Bacon, in the course of his balloon ascents this summer, made an interesting observation concerning the composition of the dust floating above London. He found that it is composed chiefly of "minute fibrous particles, similar to those produced by the wear of cloth fabric." In connection with these observations, the *Morning Post* points out that the lungs of London birds are often found to be clogged with wool and glue, while those of country birds are entirely free from such impediments to respiration.

The Deutsch Prize.—At the sitting of the Aerostation Committee of the Aero-Club, on September 7th, Mr. Deutsch called the attention of the Committee to the advisability of specifying the conditions under which the competition for the Grand Prize of the Aero-Club will take place. The Committee decided that henceforth every competitor must not only return to his starting point within thirty minutes after having doubled the Eiffel Tower, but must also touch ground within the enclosure of the Park of the Aero-Club.

The time of the trial will begin from the moment when the guide rope or any cord holding the balloon is loosened. It will end when the rope is seized by a man stationed in the enclosure. After a full discussion it was decided that the notices must reach the members of the Committee, at the latest, during the evening of the day preceding the trials.

Five members at least of the Committee must be present at the ascent; otherwise the duration of the aerial flight cannot be properly verified.

The Committee will take measures for having a watch set on the Eiffel Tower, so as to be sure that it has been really doubled as the programme requires.

Foreign Aeronautical Periodicals.

On this list a selection of some of the most notable articles is given.

L'AÉRONAUTE (Paris).

June, 1901.—Note Concernant la Construction d'un Cerf-Volant pour Recherches Scientifiques, Explorations Atmospheriques et Relevés Photographiques. Par F. J. Pillet.

Digitized by Google

L'Aérophile (Paris).

July, 1901.—Portraits d'Aéronautes Contemporains: Etienne Giraud (Emmanuel Aimé); Robert Lebaudy; Pour Revenir, (Robert Lebaudy); Le Concours Aéronautique de Bordeaux (Alexandre Sallé); Au Concours de Ballons de Bordeaux; L'Aviateur Roze; Atterrissage dans Paris (Comte Henry de la Vaulx); Bulletin Officiel de L'Aéro-Club.

July, 1901.—Portraits d'Aéronautes Contemporains: François Peyrey (Emmanuel Aimé); Congrès et Commission Internationale d'Aéronautique (G. L. Pesce); Le Droit d'Atterrir (Georges Bans); La Traversée de la Méditerranée (Georges Blanchet); 28 Juillet, 1901, La Neige (R. Binet); Epilogue de L'Epopée d'Andrée (G. B.); Nécrologie: François Jouffryon; George Falize (Wilfrid de Fonvielle); A 10,300 Mètres (G. Géo); Commission Permanente d'Aéronautique (Henri Hervé); Expériences d'Aérostation Militaire aux Tuileries; Une Fête d'Aéronautes (Georges Bans); Bulletin Officiel de L'Aéro-Club.

Revue Ampère.

July, August, September, 1901.—La Direction des Ballons (Emmanuel Aimé).

L'Auto-Velo.

September 7th, 1901.—Concours l'Appareils d'Aviation plus lourds que l'Air.—La Sortie du Santos Dumont, No. 6.

Illustrirte Aëronautische Mittheilungen (Strassburg).

July, 1901.—Theoretische Grundlagen der Ballonfuhrung, Dr. R. Emden.—Die Zivil- und Strafrechtliche Haftung des Luftschiffers, Dr. Georg Rosenberg.—Eine Landung im Gebirge, Franz Linke-Schichtbildungen in der Atmosphäre, Dr. R. Süring.—Flugtechnik und Zeppelin's Flugschiff, H. W. L. Moedebeck.—Der Flugwagen, J. Tarnowski.

Notable Articles.

During the last three months hundreds of articles have appeared in the daily and weekly papers on the subject of aerial navigation. It is impossible to give a complete list of these, as it would fill some pages of the journal, therefore a selection of articles of interest has been made for this list.

July *Review of Reviews.*—"Air-Ships."

15. *Morning Post.*—"The Navigable Air-Ship—Official Trial."
New York Herald.—"Santos Dumont Fails to Win the Deutsch Prize."

19. *English Mechanic.*—"The Balloon in Warfare."

20. *Illustrated Mail.*—"The Conquest of the Air."
Daily News.—"Santos Dumont's Balloon." Views of the Aeronautical Society.

31. *New York Herald.*—"Worries of an Aeronaut."

Aug. 9. *Daily Express.*—"Santos Dumont's Fearful Flight."

10. *New York Herald.*—"The Santos Dumont" No. 6.

17 *Navy and Army Illustrated.*—"Air-Ships Up to Date."
The King.—"M. Santos Dumont and His Air-Ship."
Sphere.—"A Twin Balloon."
New York Herald.—"Aero-Club of Vienna."

31. *New York Herald.*—"Lath Frame Air-Ship."
Sphere.—"A Night Journey Across London by Balloon."

Sept. 6. *Daily Telegraph.*—"A Spin in Mid Air."

20. *Times.*—"M. Santos Dumont's Balloon."
Public Opinion.—"The Rise of the Balloon."
Morning Post.—"Swiss Autumn Manœuvres; The New Balloon."

21. *New York Herald.* "Oversea Ballooning."
New York Herald. "A Perilous Voyage."

Digitized by Google

Applications for Patents.

(*July, August, and September*, 1901.)

This list is Compiled by Messrs. BROMHEAD & Co., 33, Cannon Street, London, E.C.

14,311. July 13. MANUEL VASSEUR and WILLIAM EVANS. Improvements in the Mode of Propelling and Directing Air-Ships.

15,960. August 8. WALDEMAR PORAK. Improvements in Flying Machines.

16,100. August 10. WALTER JAMES GRIFFITHS. An Improved Apparatus for Navigating the Air.

16,348. August 14. JAMES BLYGH WAYNMAN MAUNDER and ALEXANDER SCHANSCHIEFF. Improvements in Air-Ships.

16,856. August 22. THOMAS MOY. Improvements in and Relating to Appliances for Effecting Aerial Navigation.

16,857. August 22. THOMAS MOY. Improvements in Means and Appliances for Securing Horizontal Stability in Aerial and Submarine Vessels.

17,151. August 27. EDWARD MALLCOTT RICHARDSON. A New or Improved Navigable Balloon or Flying Machine.

17,234. August 28. WILLIAM BEEDLE. A Steerable Air-Ship.

17,369. August 30. ARTHUR CONRAN BLOOMFIELD. Attachments for the Automatic Closing of an Umbrella-shaped Messenger Travelling on the String of a Flying Kite or Balloon.

17,426. August 30. WILLIAM THORNTON. An Improved Aerial Ship or Flying Machine

17,719. (Date applied for under Patent Act, 1883, February 6, 1901.) CARLOS DE ROSTAING LISBOA. Improvements in Air-Ships.

17,966. September 9. JAMES JONES and CHARLES FRANCIS JONES. Apparatus for Propelling and Steering Aeronautical Machines.

17,984. September 9. RAOUL TURR. Improvements in Balloons.

THE

AËRONAUTICAL JOURNAL.

A QUARTERLY ILLUSTRATED MAGAZINE DEVOTED TO ALL SUBJECTS CONNECTED WITH THE NAVIGATION OF THE AIR.

VOL. VI.

1902.

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN AND PRINTED BY KING, SELL, & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, LONDON, W.C.

Digitized by Google

AËRONAUTICAL JOURNAL.

VOL. VI.

INDEX.

PAGE

Aëronautical Society, The, Notices of 1, 21, 41, 55
,, ,, General Meetings 1, 22, 41, 56
,, Exhibits, Automobile Exhibition in Paris 18
,, Instruments, New 49
Aëronautical Society of Great Britain, The President of, with Portrait 66
Aëronautics and Peace 40
Aerial Navigation by Bodies Heavier than the Air:—
I. By Sir Hiram S. Maxim 2
II. Atmospheric Currents—W. Marriott 7
III. Scientific Aspects of M. Santos Dumont's Experiments .. 11
Aerial Wireless Telephone 19
Air-Ships, The Barton—Dr. F. A. Barton (Illustrated) 30
,, The Mellin (Illustrated) 45
,, Competition, The St. Louis .. 50
Ascents, International Balloon, The 17
,, Scientific Balloon, The 21
,, The Physiology of 47
Across the Metropolis, Journey of the Mellin Airship 72
Attempt to Cross the Mediterranean in a Balloon 19

Balloon in War, The 20
Balloon, Photography from a—Miss Gertrude Bacon 28
Balloons and Kites to Wireless Telegraphy, Application of—Marconi 50
Balloon Centenary, the Bath, Recent Voyage of Comte Henri de la Vaulx 73
Balloon Ascent of Dr. Süring and Dr. Berson 46

PAGE

Berlin Congress, The International Aëronautical Commission 46
Professor Cailletet's New Apparatus for Inhaling Oxygen.. 46
Recent High Balloon Ascent of Dr. Süring and Dr. Berson 46
Physiology of Ascents 47
Ornithological Observations from Balloons 47
Measurements of Electricity in the Air from Balloons 47
Balloon-Sondes Experiments 48
Hargrave Flying Machine 48
Barton, Dr. F. A. 30
"Bristol" War Balloon during South African Campaign, Notes on—Captain H. B. Jones, R. A. 65
Berson, Dr. 46
Bacon, Rev. John M. 40, 62
Bruce, Eric Stuart, M.A. 43, 47, 59
Baden-Powell, Major B... 14

Captive War Balloon, Concerning Use of, during Siege of Ladysmith. By one of Imperial Light Horse 15
Crossing the Sahara in a Balloon, Scheme for 19
Competition, International Kite .. 21, 39, 56
Condolence, Vote of 60
Cycala Flying Machine, The, Note on Dr. Charles Zimmerman 65
Centenary—The Bath Balloon 73
Currents, Atmosphere—William Marriott .. 7
Curre ts, Aërial 19

Dumont, M. Santos 11, 15

INDEX—*continued.*

PAGE

Exhibits—Automobile Exhibition in Paris .. 18
Experiments, New, Professor Langley's .. 72
,, M. Santos Dumont's .. 11

Fatal Parachute Accident, The Sheffield .. 51

Investigation of the Upper Atmosphere by means of Kites, The 73
International Balloon Ascents 17

"Le Paix," Fatal Accident to 40
Lectures, Recent, on Aëronautical Subjects :—
I.—Scientific Observations at High Altitudes—Rev. J. M. Bacon .. 40
II.—Use of Balloons in War—Eric Stuart Bruce, M.A. 47

M. Santos Dumont, Banquet to 15
,, Plans 18
Meetings—Permanent International Aëronautical Commission 17
Maxim, Sir Hiram S. 2
Marriott, William 7
Mediterranean, Attempt to Cross 19
Metropolis, Journey of the Mellin Air-ship Across The 72

New Experiments—Professor Langley's .. 72
Navigable Balloon Scheme—M. Torres .. 73

Obituary—Sir Frederick Abel, Bart. 71

"Peace" Balloon of the late Senhor Augusto Severo :—
I.—By Dr. Carlos Sampaio, with Portrait 56
II.—By Eric Stuart Bruce, M.A. .. 59
Physiology of Ascent 47
Permanent International Aëronautical Commission, Meetings of 17

Reviews—Aërial Navigation, Frederick Walker, C.E. 74

PAGE

South Africa—War Balloon, The 14
Siege of Ladysmith, Captive War Balloon, The 15
Santos Dumont's Balloon, Collapse of the No. VI. 51
St. Louis Air-Ship Competition, The Rules and Regulations—Governing Competition—for Grand Share .. 68, 70
II.—Grand and Minor Prizes .. 68
III.—The Course 69
IV.—Award determined by Speed .. 69
V.—Line of Competitive Trials .. 69
St. Louis Air-Ship Competition—The Rules and Regulations Governing other Aerial Contests for Air-Ships, Balloons, &c. 70
I.—Air-Ships not carrying Operator and Gliding Machines .. 70
II.—Motors for Air-ships or Dirigible Balloons 70
III.—Prize of $3,000,00 70
IV.—Balloon and Air-Ship Contests, with Diagram 70
VI.—General Regulations applying to all Aëronautic Contests .. 71
Shaw, Dr. William Napier 50
South Africa, War Balloon in, Major B. Baden-Powell 14
Scheme for Crossing the Sahara in a Balloon 19
Sampaio, Dr. Carlos 56
Severo, Senhor Augusto, The late 56

Temperature, Variation with Height, N. Shaw 50
Thunderstorms, Balloon Ascents in, Rev. John M. Bacon 62
Telephone, Aerial Wireless 19
Torres, M. 73

Vote of Condolence 60

War Balloon - South Africa, Major B. Baden-Powell 14

Digitized by Google

520.5
12:45

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF M-CH
AUG 4 19?

THE AËRONAUTICAL JOURNAL



8
12
15
17

Edited for the Council of the Aeronautical Society of Great Britain.
By ERIC STUART BRUCE, M.A. Oxon., Fellow of the Royal Meteorological Society.

No. 21. JANUARY, 1902. VOL. VI.

All Rights Reserved.]

Contents.

PAGE.

NOTICES OF THE AËRONAUTICAL SOCIETY 1

GENERAL MEETING OF DECEMBER 3, 1901— 1

1. AERIAL NAVIGATION BY MEANS OF BODIES HEAVIER THAN AIR. BY SIR HIRAM MAXIM 2

2. ATMOSPHERIC CURRENTS. BY WILLIAM MARRIOTT 7

3. THE SCIENTIFIC ASPECTS OF M. SANTOS DUMONT'S EXPERIMENTS. (*Frontispiece*) 11

THE WAR BALLOON IN SOUTH AFRICA. BY MAJOR B. BADEN-POWELL .. 14

MEMORANDUM CONCERNING THE USE OF THE CAPTIVE WAR BALLOON DURING THE SIEGE OF LADYSMITH. BY ONE OF THE IMPERIAL LIGHT HORSE 15

THE BANQUET TO M. SANTOS DUMONT 15

MEETINGS OF THE PERMANENT INTERNATIONAL AËRONAUTICAL COMMISSION. TRANSLATED BY H.A.B. 17

THE INTERNATIONAL BALLOON ASCENTS 17

NOTES—THE AËRONAUTICAL EXHIBITS AT THE RECENT AUTOMOBILE EXHIBITION IN PARIS—M. SANTOS DUMONT'S PLANS—AERIAL WIRELESS TELEPHONE—AERIAL CURRENTS—THE ATTEMPT TO CROSS THE MEDITERRANEAN IN A BALLOON—THE SCHEME FOR CROSSING THE SAHARA IN A BALLOON—THE BALLOON IN WAR 18-20

FOREIGN AËRONAUTICAL PERIODICALS 20

NOTABLE ARTICLES 20

APPLICATIONS FOR PATENTS 21

LONDON:

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., GOUGH SQUARE AND BOLT COURT, E.C.

Digitized by Google

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL:—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901.

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

Digitized by Google



M. SANTOS DUMONT ROUNDING THE EIFFEL TOWER.

Reproduced by kind permission of the Editor of the "Aerophile" (Paris).

Digitized by Google

THE AËRONAUTICAL JOURNAL.

JANUARY, 1902.

The Aëronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aeronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd., 4, Bolt Court, 12, Gough Square, and 4, Birchin Lane, E.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road, Kensington, London, W.

NOTICES OF The Aëronautical Society.

At a meeting of the Council held at the Society of Arts, John Street, Adelphi, on December 3rd, 1901, the following gentlemen were elected members of the Society:—

The Hon. CHARLES STEWART ROLLS.
Mr. FREDERICK WILLIAM BISHOP.
Mr. HARRY ALAN WAGSTAFFE CAUDLER.
Mr. WILLIAM HENRY DINES.
Mr. SELWYN FRANCIS EDGE.
Mr. FREDERICK WILLIAM HUTCHINSON.
Mr. ALEXANDER OGILVIE.
Mr. HARRY JOHN SWINDLEY.

The next General Meeting of the Aëronautical Society of Great Britain will take place early in March, the exact date of which will be duly announced.

The following papers will be read:—

"The Development of Aerial Navigation in Germany," by MAJOR W. L. M. MÖEDEBECK.

"Balloon Photography," by Miss GERTRUDE BACON (with lantern Illustrations).

"Some Further Notes on the Barton Airship," by Dr. F. A. BARTON (with Exhibition of Model).

On this occasion a collection of old Prints descriptive of balloons will be exhibited by the Hon. Charles Stewart Rolls.

NOTICE TO MEMBERS.

In the event of Members of the Aëronautical Society not receiving their copy of the Journal, or Notices of Meetings, either through accidents in the post or otherwise, they are requested to immediately inform the Honorary Secretary, so that the matter may be immediately investigated.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

The opening meeting of the session of the Aëronautical Society was held at the Society of Arts, John Street, Adelphi, on Tuesday December 3rd, 1901. Mr. E. P. Frost, J.P., in the chair.

The CHAIRMAN: Ladies and Gentlemen,—I should like to take this opportunity of saying that while we all fully appreciate the work that our distinguished President has already done for the Society and is still doing, and also the work he has done in South Africa, we regret that he is not here to-night at this the Opening Meeting of our Session. I will now ask our Honorary Secretary to read the

Minutes of the last Meeting, after which he will be good enough to read a letter that he has received from Commander Scott, of the Antarctic Expedition, dated from sea.

The SECRETARY read the Minutes of the Meeting of July 15th, and also the following portion of a letter from Commander Scott, R.N., with reference to the use of captive observation balloons in the Antarctic Expedition.

"Our balloon, if used at all, will, I think, only be a possibility on some particularly fine day, which is likely to be of rare occurrence. My argument in its favour lay in the immense importance likely to attach to a short ascent of even a few hours. The making of an ascent will, I think, be surrounded with the greatest difficulty. But the possibilities are such that a trial is worth the making, even at the expense of the weight carried."

The CHAIRMAN: I may say now, ladies and gentlemen, that through the agency of our Honorary Secretary one of the distinguishing features of last session was the visit of the past President of the French Aeronautical Society, Mons. De Fonvielle, and his interesting and instructive paper that he read here on Balloons anl Ballooning in France. This visit I need hardly say evidenced the friendship which exists between this Society and the French Aeronautical Society. Another distinguishing feature I may mention is Col. Templer's reply to enquiries made by this Society as to the use of balloons in the South African War, and this reply of Col. Templer's, I may say, was the first intimation of the kind made to the public of the practical value of the balloons sent out to the South African War; and in using Col. Templer's own words I may say "these balloons were magnificently successful." (Cheers.) Ladies and gentlemen, were we in any other portion of the civilised globe, or I might say almost any uncivilised portion of the globe, it would hardly be necessary for me to introduce a man so distinguished and a man so well-known as Sir Hiram Maxim, and as we are all eager to hear what he has to say so far as his voice will allow—for he tells me that he has a sore throat, but I know he will do his best—as we are all eager to hear him, I will now call upon Sir Hiram Maxim to read his Paper. I might say that if there are any gentlemen who wish to ask any questions or to join in the discussion, they will be good enough to hand up their names to the Hon. Secretary. The discussion, I might remind you, must of necessity be rather short.

I.

Aerial Navigation by Bodies Heavier than the Air.

By SIR HIRAM S. MAXIM.

In preparing the short paper which I am to read here to-night, I have thought it best to point out some of the many difficulties which stand in the way of successful aerial navigation.

Shortly after the Franco-German War, the French Government decided to experiment with a view of producing a dirigeable balloon, and the work was put in the hands of Commandant Renard, who seems to have conducted his experiments in a thoroughly scientific manner. He commenced his experiments with cigar-shaped balloons, but as his experiments progressed, he ascertained that fish-shaped balloons, that is, those full forward and slim aft, required less power to drive them through the air than balloons which tapered off equally at both ends. In his experiments, Commandant Renard, has for the most part used electric motors driven by accumulators, which, unfortunately, are so heavy as to make it impossible to carry sufficient power to propel a balloon against even a light wind. It is, however, a fact that on several occasions Commandant Renard succeeded in making short excursions and returning safely to the point of departure, but this has always been done in what is known as a dead calm.

Giffard, the well-known inventor of the injector, proposed to make an elongated balloon no less than 1,000 feet in length. He was of the opinion that with this size a speed of 20 miles an hour could be obtained. But the expense and trouble of conducting such an experiment proved so great that the whole thing was abandoned.

Count Zeppelin, however, appears to have had both the pluck and the cash necessary to carry out a gigantic experiment of this kind. Still, I think it must be admitted that Count Zeppelin's experiments have not brought the solution of the question any nearer, or contributed anything to our knowledge of the subject.

As far as navigating the air with balloons is concerned, it has often been said that Commandant Renard reached the end of the tether, and accomplished all that could be accomplished in this direction. But it appears that Commandant Renard was rather chary about using petroleum motors in the

Digitized by Google

presence of a large amount of highly inflammable gas. At any rate, I am not aware that he has ever attempted to navigate the air with a balloon driven by petroleum engines. It is said that Commandant Renard had at his disposal an unlimited amount of skill and cash, but M. Santos Dumont went one better, for it would appear that he possessed not only the necessary skill and cash, but also personal pluck to a remarkable degree. M. Santos Dumont has taken advantage of the new and light petroleum motors which have been developed for the purpose of driving motor-cars, and by attaching one of these to an elongated balloon has succeeded in driving the balloon through the air at a pace considerably greater than ever has been done before. This has enabled M. Santos Dumont to make short excursions, and to return to the point of departure, even in the face of a slight wind, and this has never been done before. The work of M. Santos Dumont has been done with balloons as light and strong as it is possible to make them. He has had the advantage of the experience of the French balloon makers, who have probably reduced the balloon to as high a degree of efficiency as regards lightness and strength as it is possible to do. The motor which M. Santos Dumont employed is the lightest and strongest that modern science is capable of producing at this time. I think we may therefore conclude that as far as balloons are concerned, it will not be possible to greatly improve upon what M. Santos Dumont has already accomplished. He has advanced the science of ballooning further than it has ever gone before; in fact, I think he has come very near the boundary line, beyond which it is impossible for anyone to go.

A balloon in the very nature of things has to be very light and fragile, otherwise it would not rise in the air. Its mean density is, therefore, less than the air that it displaces, in other words, a mere bubble. If it were possible to make motors which would develop 100-horse power to every pound of weight, it would still be quite impossible to navigate a balloon, no matter how well made, against even a moderate breeze. It is not possible to make a balloon strong enough to be driven through the air at any considerable speed and at the same time light enough to rise in the air; therefore balloons must always be at the mercy of a wind no greater than that which prevails at least 300 days in the year.

Those who seek to navigate the air by machines lighter than the air, have, I think, come practically to the end of their tether. They cannot hope for any new developments which will enable them to do much better than they have already done. The possibilities before them are extremely small. On the other hand, those who seek to navigate the air with machines heavier than the air have not even made a start as yet, and the possibilities before them are very great indeed. In all Nature, we do not find a single balloon. All Nature's flying machines are heavier than the air, and depend altogether upon the development of dynamic energy. In Nature's machines the amount of energy developed for a given weight is very great indeed, but no greater than the artificial motors which we are able to produce at the present time. It is quite true that a bird can develop a great deal more energy from a pound of carbon consumed than it is possible to develop with any artificial motor, but on the other hand, Nature has not yet developed a bird that can feed on petroleum, and petroleum carries much more energy in proportion to its weight than any food on which it is possible for a bird to feed. Petroleum motors have already been developed which are sufficiently light to propel machines which fly after the manner of a bird, and we shall fly whenever we ascertain how this power may be advantageously employed. It is now only a question of time and money.

Although the difficulties which have been encountered by the balloonists in order to reduce the science to its present degree of perfection have been very great, the troubles which beset the men who would make a flying machine are still greater. The action of the air appears to be very erratic, and I propose to show some of the phenomena that one who conducts experiments with true flying machines may expect.

My first experiments were made with what might be called a "merry-go-round"—that is, I had a long arm mounted on a pivot which described a circle exactly two hundred feet in circumference. To the end of this arm I attached a cigar-shaped apparatus driven by a screw and arranged in such a manner that aeroplanes could be attached to it at any angle. This apparatus was provided with various instruments which enabled me to accurately ascertain the thrust of the screw, the power required to drive the screw, the lift of the aeroplane, and the speed in miles per hour. The first aeroplane attached was about 4 feet long, and 16 inches wide, the underneath side being slightly concave, and both the edges being made sharp, it being understood that the aeroplane was driven sidewise through the

Digitized by Google

air. I first attached it with an inclination of 1 in 14, and fastened to each of the corners strong wires so as to prevent the plane from being deformed by the lifting. Each of these wires was strong enough to stand about three times the total lift of the aeroplane. However, when the apparatus was started, and when a speed of about 45 miles an hour had been attained, it was found that the lifting effect was very uneven indeed, due probably to a light wind, and eddying currents of air. The result was that one of the wires was broken, the aeroplane destroyed, and the broken fragments destroyed the screw. After this I employed much stronger wires.

In these experiments I found that I could lift and carry at the rate of 133 pounds to the horse power, whilst I also found that it was necessary to have a speed of at least 40 miles an hour in order to produce good results.

When we fly a kite, the kite is held up against the wind by the pull of the string, and as the string is at an angle, the kite is also pulled downwards at the same time. A good kite will mount in the air until it reaches an angle where the downward pull of the string is four or five times greater than the pull against the wind. In a flying machine, the screw thrust holds the machine up against the wind or drives it through the air, which is the same thing, and the weight of the apparatus is the downward pull. Professor Langley has called the upward pull of a kite or aeroplane the lift, and the tendency of the machine to travel with the wind the drift, which, of course, is identical with the screw thrust necessary for driving a machine through the air.

With my "merry-go-round" I was able to produce fourteen times as much lift as drift, but when I made an aeroplane a foot wide, slightly concave on the underneath side, and sharp at the edges, and mounted it in a strong blast of air blown through a discharge-pipe 3 ft. square at a velocity of 42 miles an hour, I was able to obtain a lift eighteen times as great as the drift, and I think Mr. Horatio Philips, who is a very careful and clever experimenter, has also obtained a lifting effect eighteen times as great as the drift. In a true flying machine, the screw thrust must, of course, be equal to the drift, and it would be an exceedingly simple matter to make a flying machine on the aeroplane system provided we were able to produce on a large scale the same amount of lift in proportion to the drift that we are able to produce in a small experimental apparatus.

Small aeroplanes are easily made of wood, and the wood is stiff enough to prevent their being deformed by the action of the air. However, when we increase their size, we must seek something lighter than wood. In some experiments that I made with moderate-sized aeroplanes, consisting of fabric drawn tightly over a wooden frame, I found that I could only carry at the rate of 40 pounds to the horse power. Moreover, size itself is an important factor. If we should arrange a dozen aeroplanes, each a foot wide, in the air, one directly behind the other, we should find that the forward aeroplane lifted a great deal more than the one next to it, whilst the last of the series would lift very little indeed. The first aeroplane is continually striking new air, the inertia of which has not been destroyed, and in order to produce a lifting effect, it throws the air downward; consequently, all the aeroplanes which succeed this are riding on air the inertia of which has already been disturbed—in other words, the air is travelling downwards and the lifting effect becomes greatly reduced. So with large aeroplanes, the front edge practically does all the lifting, and the only way to obviate this is to make the aeroplane in the form of a curve so that the angle is always increasing, which, however, again increases the amount of power required.

In my large machine, when I ran my engines up to 360-horse power, I had a screw thrust of 2,200 pounds. If I had been able to lift even ten pounds to each pound of screw thrust, the total lifting effect of my machine would have been 22,000 pounds. But my aeroplanes were very large, and it was necessary to employ an immense number of struts, braces, and wires in order to give them the necessary rigidity, and to hold them in position, and all these offered great resistance to being driven at a high velocity through the air. The result was that with a screw thrust of 2,200 pounds, and a speed of 42 miles an hour, the lifting effect on my machine, instead of being 22,000 pounds as I had hoped, was only slightly over 10,000 pounds, and as the weight of the machine complete was 7,500 pounds, the margin of lifting effect was not very great, and even this was only obtained by the expenditure of an immense amount of power. It was originally intended by me to employ only 100-horse power, but the atmospheric resistance due to the wires and braces was so great that I ultimately mounted to 360-horse power, which required a steam pressure rather more than 300 pounds to the square inch.

Digitized by Google

I employed screw propellers 17 feet 11 inches in diameter, each with two blades. The mean thrust of each of these blades would, of course, be 550 pounds. These screws were provided with stays to prevent their being bent forward by the thrust. At first I employed wires with a margin of safety of four, but these gave way when the engines were only developing about 200-horse power, allowing the screw-blades to be bent forward, when they not only destroyed themselves, but also the greater part of the machine. Ultimately, I was obliged to employ wires, which would hold a load of at least ten times the average strain that was brought upon them, and this was due to the eddying of the wind, which put sudden and unexpected strains upon the screws. It will be remembered that my machine was mounted on a steel railway track, having a gauge of nine feet, and that there was another track having a gauge of 35 ft., outside and above this, with a reversed rail as one might say, and that the machine was mounted on springs in such a manner that the lift could be accurately measured. When, however, the lifting effect was sufficient to move the load from the steel track of nine feet gauge, another set of wheels came in contact with the inverted track which prevented the wheels from being lifted completely off the lower track.

I had at first intended to prevent the machine from being lifted off the lower track by employing cast-iron wheels of very great weight. It appeared to me that I should then be able to measure the tendency that the machine had to lift off these wheels, which would enable me to place the centre of lifting effect directly over the centre of gravity. However, when running along the track at a speed no greater than 35 miles an hour, a slight puff of wind caused the machine to lift from the track, wheels and all, and coming down, the wheels sank deep into the soft wet earth. Another slight puff of wind tipped the machine completely over, breaking the framework, and doing damage which cost at least £1,000 to repair. It was only when it was found quite impossible to keep the machine on the track at anything like a moderate pace that I was forced to provide the upper track of 35 feet gauge, and even with this it was impossible to obtain anything like accurate measurements as to lift, except in a dead calm. If the wind was blowing across the track at a velocity no greater than four miles an hour, the lift on the windward side of the machine would become excessive and dangerous, whilst the lift on the leeward side would be correspondingly diminished.

In one of my last experiments, I tied the machine up to a dynamometer, and ran up the steam pressure until the screw thrust exceeded 2,200 pounds, and then when the engines and everything were developing this tremendous amount of power, the machine was suddenly detached from the dynamometer, and darted forward with a suddenness for which the crew of four men were not quite prepared, for every man who was not holding on to something with his hands was thrown down. We soon obtained a speed of 42 miles an hour, when all the wheels were seen to be running on the upper track, and revolving in the opposite direction from those on the lower track. After running about 1,000 feet, one of the axletrees for holding the machine down doubled up. This put the whole lift of the machine on to the other three. The upper track was broken, the machine was liberated and floated in the air, giving those on board the sensation of being in a boat. However, a piece of the broken track caught in one of the screws; at the same instant I shut off the steam, and the machine stopped and settled to the ground, the wheels sinking into the soft turf, without leaving any other marks, showing that the machine came directly down, and did not run on the grass before coming to a stop.

In making these experiments, the wheels that engaged the upper track did not come in contact until the machine had lifted about six inches. The first five inches of lift were employed for working the pencil on two dynagraphs, which furnished a diagram of the lift through the entire length of the road. At the end of the five inches, however, the machine had to lift completely off the lower wheels. By this means, not only did we have a diagram showing the exact lift off both the forward and back axletrees, but by painting the wheels before starting we could easily ascertain at what point the machine was actually lifted from the lower track, and came in contact with the upper track.

These experiments demonstrated that a machine could be made on a large scale in which the lifting effect was considerably greater than the weight of the machine. At that time, the steam engine appeared to be most suitable for the purpose, but since that time, great improvements have been made in the direction of extreme lightness in petroleum motors, and I am strongly of the opinion at the present moment that very much better re-

Digitized by Google

sults could be obtained with petroleum motors than I obtained with a steam engine. Moreover, the quantity of water required is about seven times as great with a steam engine as that required to cool the cylinders of a petroleum motor of the same power.

In my first experiments I had provided a very light condenser, which on account of being driven through the air at a high velocity was very efficient, so that the weight of metal was only one pound for the water condensed from each horse power. I was able to condense all my steam when the power did not exceed 100-horse power, but it was quite out of the question with 360-horse-power; consequently, my water-supply would only last for a few minutes.

Not only have great improvements been made in motors, during the last ten years, but aluminium has been greatly improved. I have seen specimens of aluminium hardened with from 20 per cent. to 30 per cent. of magnesium which are quite as light as pure aluminium, and yet have the strength and stiffness of wrought-iron. This puts into the hands of the engineer a light and reliable material infinitely better than anything that could be obtained at the time I conducted my experiments.

My experiments were made at Baldwyn's Park, but the amount of room at my disposal was insufficient, as I found a great deal of manœuvring would be necessary before I should be able to cast off and launch the machine into free air. The art of managing a flying machine in the air without practice is like attempting to learn to ride a bicycle without a bicycle or learning to skate without skates. It is difficult to learn the art of flying without actual practice in the air, and the actual management of a machine in the air, no matter how perfect, will require quite as much skill as is required to ride a bicycle, as well as the nerve and the pluck of a Santos Dumont. I think it will therefore be obvious that those who would navigate the air with machines heavier than the air have a task before them which is worthy of their steel. However, we have the motive power and the material at hand, and with skill, pluck, and plenty of cash, as well as room for manœuvring close to the ground, actual flight on true flying machines is not only possible, but practicable, and when such a machine makes its appearance, although it may not be profitably employed for carrying passengers or freight, it will yet be of inestimable value to the Empire for military purposes.

Mr. Percival Spencer: I think, possibly, we shall all agree that the one important point that has been given to the world to-night is that Sir Hiram Maxim considers the steam engine that he used is very much superseded at the present time by the ordinary motor car oil engines, so that having this extra means at our command we have an extra assurance of navigating the air by means of the aeroplane.

Mr. E. Humphrey Wingfield: I was exceedingly interested in this subject which was rather foreign to my own experience. There was one remark Sir Hiram made, if I understood him correctly, that the friction of the surface air was practically nil. At the sister institution, the Civil Engineers, there is a discussion going on to-night on the resistance due to the air experienced on railways, and my own impression is that the friction on the side is comparatively unimportant; it is chiefly the end of the train. This bears rather on the same subject, and I should be glad if Sir Hiram would tell me if I understood him correctly in saying that the surface friction was really negligable.

Sir Hiram Maxim: Mr. Chairman, Ladies and Gentlemen—In regard to the wind, there are very few people who get a proper grasp of the conditions of wind, that is when they have left the surface of the earth. No matter what velocity of the wind may be blowing, the fleeciest cloud is not torn asunder provided it is far enough from the earth. The rolling and the tumbling effect and the ebbing is produced when the clouds are passing over mountains and trees. Professor Langley has conducted a series of experiments in Washington to show that the movement of the air, the irregular lifting and the ebbing, is due altogether to the unevenness of the surface of the earth over which it passes, just exactly as when we see a large stream of water flowing over boulders, we can tell where the boulders are by the motion of the water. But there is one thing that we should always take into consideration, and that is although the air may appear perfectly stationary to a balloon, if we throw a feather or a piece of gold leaf overboard it keeps along with it notwithstanding the fact that the wind might be blowing at the rate of 50 miles an hour. We might say that we are in the wind, that is the ocean we are in, and so far as we are concerned the earth is travelling through the air like ourselves in the balloon or in the flying machine. Suppose the wind was blowing at the rate of 40 miles an hour, if we wish to keep over the

Digitized by Google

same spot we should have to travel through the air 40 miles an hour. Again, if we were travelling 40 miles and we were travelling in the other direction, we might go 60 miles an hour. That is one of the conditions we find in the air, and it is the condition that one must meet if one travels through the air. We must always consider that the air is moving as related to the earth. We do not wish to go to some point in the air, we wish to leave one part of the earth and go to another; and if we find the air is going at the rate of 20 miles an hour we are not able to go unless we are going in the same direction as the wind. That has been the trouble with all sorts of balloons for navigating the air. When I was in France one of the experimenters told me that the speed of their balloons was always just a little less than the speed of the air, the result was they always went along with the wind whether they wanted to or not. Suppose now, gentlemen, that we should make the strongest balloon that was possible and used the strongest Japan silk, and used the lightest varnish and charged it with hydrogen gas and made it as strong as we could, and suppose then, we should attach it to a locomotive, when the locomotive was moving slowly along it would follow the locomotive, when we reached 15 miles an hour the front of the balloon would become deformed, a pocket would be formed, and the instant it was formed it would tear it to pieces. It is impossible to form anything that will stand the air equal to the velocity that one finds at least 300 days in the year. Now with regard to the matter of friction, my experiments proved that so far as moving bodies were concerned, atmospheric skin friction might be considered not to exist at all, it was a quantity so infinitely small that it might be neglected altogether.

The CHAIRMAN: I now call upon Mr. William Marriott to read his paper on Atmospheric Currents.

II.

Atmospheric Currents.

By WILLIAM MARRIOTT.

MR. WILLIAM MARRIOTT: Mr. Chairman, when your Secretary asked me some months ago if I would come here some evening and speak at the Meeting of the Aëronautical Society on the subject of air currents or something of the kind, I was unable to do so at the time. But once again he came to me and I foolishly said "yes," and since I have had notice of this Meeting I have been regretting that I did say yes, because I am afraid whatever little I should have to say would be of a very elementary character and would not be of much service after all. However, I propose to show you some slides to-night and to treat the subject more from a meteorological, than an aëronautical point of view, and if you will bear with me for a little introduction leading up to the upper air we may, perhaps, be able to pass a few minutes' time together.

The remarks which follow refer to the slides shown to the Meeting, which, for obvious reasons, cannot be reproduced herewith.

We will assume that we are treating the subject from a meteorological point of view, and, therefore, we will start as a meteorological observer. First of all we have a representative meteorological station, which is an inclosure containing thermometers, raingauge, anemometer and various instruments for recording the temperature of the air, the amount of rainfall, the force and velocity of the wind, etc. The Stevenson screen contains four thermometers, one showing the highest temperature, one the lowest, the third shows the temperature of the air at the time, and the fourth, by the side, is to show the amount of moisture in the air. But we are not dealing with that subject to-night; we propose to deal rather with pressure, and that means that we use a barometer, two patterns of which are shown here, the Fortin standard barometer, with an adjustable cistern and the Kew pattern barometer with a closed cistern. By this means we can ascertain the pressure of the atmosphere at a given place.

That is a view of the Royal Observatory; it shows the anemometers for recording the pressure and velocity of the wind. These observations have been carried on for many years. This is the Osler pressure anemometer; it has a vane with a pressure plate kept face to the wind, and it continuously records on the table below both the direction and the pressure of the wind. As is shown in this diagram it gives the direction of the wind for 24 hours right through the day. Here the wind has been S.S.E., then it changed to S.S.W., and then, subsequently, to S.W. The pressure is given here in lbs. per square foot. This was the day of the gale, December 29th and 30th, 1899. For recording the velocity of the wind an anemometer called Robinson's is used. The cups were supposed to revolve at

Digitized by Google

one-third of the velocity of the wind, and the dials have been graduated on that assumption; but of recent years that factor has been found to be too great and the coefficient should be about 2.2 instead of 3.

This slide shows the record taken at the Royal Observatory, Greenwich, with a similar instrument on the same day. Nearly 800 miles were recorded during the 24 hours at the Royal Observatory on this day. Well, where we have not a recording instrument we have to estimate the force of the wind on what is called Beaufort's Scale. This was a scale devised by Admiral Sir Francis Beaufort for sailing-ships in the Navy; but sailing-ships have gone out of date altogether, still the scale is used at the present time and we have the equivalent velocities per hour against each half of the scale. This (referring to diagram), gives the velocities to the old factor 3, and this to the revised factor 2.2.

Having got our observations we may treat them in two different ways. The old plan used to be to collect observations, make them day after day and year after year, and sum them up and take the average or the mean for as long a period as possible. If we do this we get the climatic features of a place, and by comparing the climatic features of one place with another we are able to determine what the characteristics are of any parts of the country or all over the world. That is called "climate." In contradistinction to that we have "weather," which is the weather existing at the same instant of time over a large part of the country. We compare it at 9 o'clock, and at the same hour it is taken at Falmouth, or Edinburgh, or any other part. But the first, "climate," is arrived at by taking the average over a long period of observations. Taking the direction of the wind at the Royal Observatory, Greenwich, for something like 40 years we find S.W. is the prevailing wind with 106 days out of the 365, whereas there are 41 W., 40 N., 42 N.E., and so on.

Now if we put our observations on a map, supposing these figures represented the various places and this was an observation at, say London, this Liverpool, and so on, they do not show us very much, but if we draw a line and join certain parts which have the same figures as shown here, we find that we get certain areas enclosed by continuous lines. If we do that, we can dispense with the figures and use the lines only and get a figure something like this. Now if we use this figure or these lines they will serve either for temperature or pressure. If we use them for temperature we call them "isothermals," or lines of equal temperature; or for pressure we call them "isobars." By adopting such a plan we can draw maps of anything we like. For instance, here is a temperature map of the globe for the month of January. The barometric pressure is dependent very largely upon the question of temperature, but I am not going into that to-night. This shows over the northern hemisphere that the temperature is cold, whereas in the southern it is warm; but here we get extremely cold, especially in Siberia. In July, the conditions are different; we have very little cold comparatively, it is confined mostly to the southern regions, and it is much warmer over the Continents.

Now, if we take a map of the atmospheric pressure, with which we have more to deal, we have for January high pressure in the northern hemisphere over the Continents, and the highest pressure of all in the interior, where we saw that intensly cold patch just now; whilst over the North Atlantic we get a lower pressure; and in the southern hemisphere we get a comparatively low pressure over the land. I want you also to notice on this map that the direction of the wind is shown by these arrows; you will also notice that there is a relation between these arrows and the direction of the isobars. Mostly the arrows run very nearly parallel with the isobars, but we shall have to speak about that a little more presently. You will find with the high pressure there is a tendency for the arrows to come outward, whereas with the low there is a tendency for them to come somewhat inward. Taking the map for July we find a contrast; we had the high pressure in the northern hemisphere in January, whereas we get it in the south in July, and we get the lower pressure over the Continents because as I said there was a connection between the temperature and the pressure. A Dutch meteorologist (Buys Ballot) some years ago went into the question of the relative direction of the wind to the isobars, and he propounded this law: "Stand with your back to the wind and the barometer will be lower on your left hand than on your right." This is a fundamental principle. Now we will try and apply that to some of the charts that we shall view.

Digitized by Google

Here is a specimen of a weather chart published by the Meteorological Office, where we have North-West Europe with the low pressure, or the barometer is lowest, in this district, and highest down here. (Indicating.) There is a considerable difference, and it shows there is an inch and a half difference between those two parts; the wind consequently is rather strong, and it blows, as you see, very nearly parallel with these lines, but here it has a tendency to blow inwards into the centre of the low pressure, whereas it blows outwards from the centre of the high pressure. The closer these isobars are together the stronger is the wind.

Now take a different type. Here we have the wind not so strong; the isobars are farther apart. I may tell you the nomenclature for this high and low pressure system—for the low "cyclonic" or "cyclones," and for the higher pressure "anticyclones" because it is assumed that the weather conditions are practically opposite the one to the other. As I have already said, round the low pressure the wind blows this way, that is in the opposite direction to the way the hands of a watch go, whereas with the high pressure it goes round with the hands of the watch, and the weather conditions are thus practically opposite the one to the other.

Now here I want to point out that we have high pressure there, while we have here a wedge or ridge of high pressure, another pressure here and a low pressure going out there. (Indicating.) When it occurs somewhere about here there is usually a calm, the wind is blowing that way, and it is influenced by that low pressure, whereas this wind is influenced by the incoming low pressure. Cyclonic systems have a tendency to travel usually in a N.E. direction.

Here is another chart showing high pressure over Scandinavia and also over the South-West of Ireland, whereas low pressure is down here and we get over England and Wales northerly to north-easterly winds. Under such circumstances the wind is particularly keen and very dry.

Now here is another type. I do not know—I have not been up in a balloon and I have not had anything to do with ballooning—but I daresay it is very desirable to know what direction the balloon is likely to take, and sometimes it is a difficult matter to see where it will go. If you have such a type as this, supposing you were here and you had a south-westerly wind you would think you were going in a north-easterly direction. Well, after a time with a little disturbance like this you would find when you got up some distance that you were influenced by some other current. You see here there is a general low pressure, but there has been some little depression or subsidiary disturbance which affects the whole of this district, and this usually brings bad weather and throws one out in one's assumption of what the coming weather is likely to be.

Here we have certain types set forth; these are largely hypothetical. High pressure shows here with the wind circulating round in the direction of the hands of a watch but blowing outwards, and in this usually the air is quiescent or calm and the wind comparatively light. On the outskirts of that there are usually depressions or cyclones passing along round it, but usually taking this direction. Here, we have a well-marked depression, and here is another, and here another; but you will notice that in between there are eddies which indicate the ridges of high pressure, and in here we get bright weather, but next morning we get wind or bad weather due to the on-coming depression, and then we have a cyclone brought in which upsets the calculations of those who forecast the weather. Between two high pressures there is a V-shaped depression, and that brings variable weather, sometimes such weather as upset Her Majesty's ship *Eurydice* off the Isle of Wight some years ago.

Now, we have been dealing with what takes place upon the surface of the earth, and our instruments will only show us that. We can only get our information as to what goes on above at present from the motion and forms of the clouds. The study of clouds has been taken up for very many years past. Luke Howard was one of the first who devoted attention to it systematically, and it is now carried on especially all over the Continent of Europe and other parts by people who are observing the forms of clouds, their rates of velocity, and also their altitude.

Here is a picture showing the various forms of clouds with the names given. The lowest is stratus, then nimbus, cumulo-stratus, cumulus, strato-cumulus, alto-stratus, alto-cumulus, cirro-cumulus, cirro-stratus, and cirrus. The difficulty under which meteorologists work is that there may be a fog and so we cannot see the sky, and we can only do so by going up mountains or in balloons. But we wish to ascertain the currents of the air, and we trust the members of the Aëronautical

Digitized by Google

Society will be able to help us somewhat in this matter.

Now just to show a few more specimens of clouds we will pass these slides very hurriedly through. I will not attempt to describe them because the time is passing on. That is a cumulus cloud. It was taken by the Hon. Ralph Abercromby, and the next two or three were also taken by him. Mr. Abercromby devoted a very great deal of attention to the forms of clouds and also to their altitude. He conversed with a good many meteorologists in various parts of the world and helped to devise that nomenclature which we saw on the screen just now.

Now we get to some higher clouds. That is the cirro-cumulus, and we shall soon get up to cirrus, the highest of all. That particular one was taken in Sydney, New South Wales, by Mr. Russell, the Government astronomer.

Here is Cirrus, or the highest of the clouds. Clouds have been seen by balloonists at all altitudes, even the highest to which they have gone.

This is a portrait of Mr. Glaisher, who made the highest balloon ascent on record. He was my old master, and devoted a very great deal of attention to this subject. He found in his balloon ascents that as a rule they went faster than the anemometers showed the record of the wind below. And at times they went in various directions; sometimes they had three or four different currents, and, fortunately for him, he came down in safety on each occasion. Now, recently, observations have been made, or attempted to be made, with kites, especially by Mr. Rotch, of the Blue Hill Observatory. Mr. Rotch has read two or three papers before the Royal Meteorological Society, and I am permitted to show some of the photos which he sent over to illustrate his paper.

This shows the method of kite-flying. This is the Hargreave or box kite, and this Mr. Clayton's keel kite; they had three or four kites to help each other, and suspended from them was an apparatus for showing the temperature and humidity of the atmosphere.

This is the Hargreave kite. This shows the method of raising the kite, and by such means they were able to obtain a record something like that shown on the screen. This was taken October 8th, 1896; it gives the barometric pressure showing that they went to an altitude of about 8,000 ft. Here is the record of the humidity; and this shows the temperature. Mr. Rotch has recently propounded a scheme for flying kites at sea. We have a difficulty in getting observations or of knowing anything of what was going on in the atmosphere over the sea. He proposes that kites should be flown on a steamship, and he has practically demonstrated the feasibility of this on two occasions.

This is the first, in Massachusetts Bay in August last; here is the windlass and here is Mr. Rotch himself. From that he went on to flying kites as he came across the Atlantic from Boston to Liverpool in the steamer, *The Commonwealth*. While out at sea he obtained records on three days, particulars of which are given here. This shows the temperature on board the ship; this the one up above, and so on for the three days. This gives the record of the barometer for the three days, showing that on this occasion the height was higher on the last day. This shows the relative humidity on board ship and also up in the air; whilst the top line shows the velocity of the wind. We have heard to-night about the balloons floating with the wind, and that is the great difficulty with regard to meteorological observations in balloons, because the balloons float along with the wind. We want to know what goes on there. There is no circulation around the thermometers, nor do we get any wind record on the anemometer. But with kites we get both the direction and the velocity of the wind. If the Aëronautical Society can help the Royal Meteorological Society in obtaining information on the subject of the upper air we shall be delighted.

Mr. Percival Spencer: I think I might say with regard to the Beaufort Notation as given there, there is one very peculiar effect. The greatest wind used to be recorded as 100 miles an hour; I notice it is 77 miles an hour. I was at Wincanton, in Somerset, and in an hour and a half we descended in Norfolk 180 miles away—from half-past three to five o'clock. The balloon had actually been travelling at 120 miles an hour. That scarcely agrees with this maximum of 77 miles an hour.

Mr. Marriott: I think I stated that we deal with anemometers on the ground. The balloon is carried a considerable distance above the earth, and Sir Hiram Maxim has also stated that it is the buildings and the contour in the country which affect the currents of air. Your balloon was above this probably, and there was no resistance.

Digitized by Google

The CHAIRMAN: In passing on to the next paper, ladies and gentlemen, I may say that, together with the Aero Club of the United Kingdom, which has recently entertained at a banquet the intrepid and brilliant aeronaut with Lord Dundonald in the chair, we, of the British nation, admire and do honour to any man, of whatever nationality, who, at the risk of his life, achieves victory over natural obstacles M. Santos Dumont has done this, and we hope that the achievement that he has already accomplished in making the balloon somewhat steerable will lead on to greater achievements. I will now call upon Mr. Bruce to speak on M. Santos Dumont's experiments.

III.

The Scientific Aspects of M. Santos Dumont's Experiments.

(*Frontispiece.*)

Mr. E. S. BRUCE: My first feelings on rising to speak to you of M. Santos Dumont's experiments are those of regret that the President of our Society is not here this evening to undertake this task, for I cannot help picturing to myself how consummately he would have addressed you, and the mental image I have before me of his earnestness when discoursing on an aerial topic seems to deaden my own efforts. But I will ask you to patiently hear a few words from me as his substitute. I think all present will agree with me that it is the duty of every scientific society when examining the details of any new experiment that falls within its scope to search diligently for the truth; and, therefore, it would seem to be the duty of the oldest Aeronautical Society in the world to examine carefully the conditions under which the experiments of M. Santos Dumont were made, in the endeavour to ascertain what truths they teach. Not that I think that the whole truth can be discerned in one meeting. There is an old saying of Tacitus that truth is brought to light by time and reflection, not by haste. I will, however, bring before you a few scientific facts and make a few suggestions that may help our effort to discover how exactly the experiments of M. Santos Dumont form a landmark in the history of aerial navigation.

It may, perhaps, throw light upon the question if we look back upon the past history of navigable balloons. M. Giffard was the first to devise a navigable balloon. He discarded the ordinary spherical shape of the balloon and adopted an elongated form pointed at both ends. He employed steam for the motive power, making a light engine and boiler as shown in the picture. The engine worked a screw 12 feet in diameter. Behind the screw there was a rudder, a kind of triangular sail. You will notice that the chimney of the boiler is inverted so as to minimize the danger of the gas in the balloon becoming ignited. M. Giffard ascended in his balloon on the 24th September, 1852. There was a strong wind blowing at the time, and he never attempted to struggle directly against it, but only made circular movements and lateral elevations. I have often wondered why, after these elaborate preparations no future experiment was made. M. De Fonvielle, who was an intimate friend of M. Giffard, told me the other day that the real reason was that M. Giffard was dissatisfied with the boiler he had evolved, and on account of the boiler gave up the experiments.

The brothers Tissandier, in 1883, devised a balloon of somewhat similar form in which the motive-power was electricity, and it is stated that with this balloon they held their own against a wind of nearly three metres a second.

The experiments of Capts. Krebs and Renard in 1885 were noteworthy as being the first in which a direct return journey was made to the spot whence the balloon started. Before you, on the screen, is a picture of the balloon, "La France" pursuing its aerial way above the Pont du Jour, Paris. This is the facsimile of an instantaneous photograph executed at the Observatory of Physical Astronomy at Meudon. You notice the bird or fish shape of the balloon. The screw was worked by means of an electric motor fed by a bichromate battery of special construction. In the accounts Capt. Renard sent in to the French Academy, it is said that out of seven journeys this balloon returned five times to the place from which it started. The map on the screen shows you a series of three journeys. This dotted line represents the journey of the 25th August, 1885. This journey, as you see by the abrupt cessation of the dotted line, was abortive. The balloon started from Meudon and was unable to make a return journey. The second dotted line represents the ascent of the 22nd September, 1885, in which a return journey was actually performed. On this day the wind blew from the north north-east from Paris at a velocity of from 3 to 3.50 metres per second. Start-

Digitized by Google

ing from Meudon, the balloon was directed towards Paris at 4.25 p.m. It crossed the railway line at 4.55 p.m., reached the Seine at 5 o'clock. At 5.12 the balloon entered the enceinete by the bastion 65. Then the aeronauts decided to go home. The balloon was easily turned, and aided now by the aerial current reached the exact spot whence it had started. The part of the journey against the wind took 47 minutes, the part with the wind 11 minutes. On the day following a very similar journey was performed as shown by the thick line in the diagram. Thus Capts. Krebs and Renard in 1885 succeeded in steering a balloon, making return journeys in such very light winds as amounted to calm weather. Possibly the question may occur to some whether, if in 1885 there had been a prize offered for a navigable balloon that would go from a certain point, round a certain point, and back to a certain point in a certain time, it might not have been won by the balloon "La France." In principle there is nothing against such a supposition. I would, however, suggest that the bichromate electric battery used for the purpose of working the electric motor would have been a very unsatisfactory method of obtaining power for the screw, for any lengthy series of experiments.

Next we come to the experiments of Count Zeppelin with his enormous airship, 420 feet long and worked by means of two Daimler petroleum motors of 16-horse power, several pictures of which were exhibited at the meeting of this Society in April last. The most novel feature of this undertaking was the aluminium framework, which contained 17 distinct balloons, thus affording protection from a sudden collapse of the whole structure. The best journey from a scientific point of view undertaken by this airship was on October 21st, when a short return journey was made, the airship being up 20 minutes only. But it does not appear that the airship encountered a greater windforce than that experienced by Capts. Krebs and Renard, being about three metres a second.

The next series of experiments are those of M. Santos Dumont. I have no hesitation in saying that we are now considering the work of a very remarkable man, and this much can certainly be said, that he is the first aeronaut in the history of aerial navigation who has steered a balloon from a given point, round a given point, and back up to time. Thus if he has not advanced aeronautics in principle he has undoubtedly in practice. There is also much to admire in the personal qualities of M. Santos Dumont. What qualities are dearer to the British heart than pluck, courage, and dogged determination to attain the object sought? All these qualities have been vigorously displayed in M. Santos Dumont's work. To him temporary failures which would have crushed and defeated less manly spirits have been merely instructive stages of airship construction. The work of M. Santos Dumont, too, has shown an exceptional originality of detail. For instance, the introduction of the ballonet, or inner balloon, to maintain the rigidity of the outer envelope, seems an inspiration. By a most simple experiment I can demonstrate to you the action of this ballonet. Here is a small goldbeaters' skin balloon. In the inside of this there is a much smaller one. The outer balloon has lost its rigidity, it is, in fact, *quite flabby*. But I blow air inside the inner balloon and you can see the outer balloon extending until it is as light as a drum. Now it is most important for a navigable balloon that it should keep its shape rigidly, if it is to combat any wind. M. Santos Dumont pumps air into the inner balloon by means of a fan to keep the envelope rigid when it gets flabby by loss of gas. The importance of the ballonet was proved by the accident of August 8th. On this occasion the ballonet apparatus did not work properly, and the balloon lost its rigidity and got entangled in the machinery, with the result that M. Santos Dumont had to precipitate himself on to the roof of the Troccadero Hotel.

To further exemplify the importance of the rigidity of the envelope of a navigable balloon I will show you a simple experiment.

1. On this balloon, which is fully and rigidly inflated, I drop a heavy weight. It bounds off the balloon leaving the delicate structure undamaged.

2. On this second balloon, which is flabby, I drop a weight and the balloon bursts.

I might mention various other ingenious details of M. Santos Dumont's mechanism and accessories. Such as the abolition of the time-honoured net, and the fastening of the framework which supports car and apparatus to the balloon by rigid steel wires.

But the main point in a navigable balloon experiment is the wind force overcome. How has M. Santos Dumont made any advance over his predecessors in this important respect? I was very anxious to throw some light on this point by figures, so I took advantage of our friendly relations with La Société Française de Navigation Aerienne, and wrote

Digitized by Google

specially to enquire the wind force on the day M. Santos Dumont won the Deutsch prize. With that courtesy and consideration that invariably shown by the Société Française de Navigation Aerienne to our Society, I had a prompt reply. In fact, M. De Fonvielle, the late President of the French Society paid a special visit for us to the Eiffel Tower where registering anemometers are kept day and night in operation at an altitude of 305 metres from the ground, and he found that at 2.42 p.m., when the balloon started from the grounds of the Aero-Club, the wind had a force of 4½ metres per second. Eleven minutes later when the balloon rounded the Eiffel Tower it had increased in force and was about 5 metres per second. Now I think these figures prove that M. Santos Dumont has made an advance as regards the wind force overcome though it is a small one, about a metre and a half a second over the wind encountered by Captains Krebs and Renard in 1885. In these experiments the due measurement of the wind force is of the utmost importance, and measurements should undoubtedly be made on the airship itself, though there are difficulties in taking anemometer measurements on a moving body. As far as I can ascertain M. Santos Dumont did not have a registering apparatus on the airship on the day on which he won the prize. M. De Fonvielle states that the Société Française de Navigation Aerienne are about to undertake navigable balloon competitions, and that a condition imposed upon competitors is that every competitor must take a registering anemometer on his airship. I should like to throw out a further suggestion, that in any future competitions for a prize the wind force should be a condition of the competition, and that the competitors should no longer be free to select their own days, which, in the past, have been calm ones or those of very light winds.

It is now proved that a balloon can be navigated in a very light wind; but we must go further and test by experiment whether, as Sir Hiram Maxim thinks, the limit has been reached. This may seem a cruel suggestion, for if the limit has been reached, in such a competition the balloon will burst when forced against a wind of even breezy proportions. I do not want to dogmatise, for the duty of a secretary is rather always to hold the scales, to be ever weighing for others to draw conclusions; but I will say this much, that in such a competition I should advise the competitors to be provided with parachutes, and not only to be provided with them but to be thoroughly practised in their use, for they may have to leave their balloons in floating fragments behind them. It will be urged that it would be difficult to fix a definite wind force. Where is the wind force to be fixed, near the ground or 300 feet high, at the beginning, middle or end of the competition? I do not under-estimate the difficulties in the way of fixing such a wind force limit, and it is a matter requiring much consideration and discussion.

A series of lantern illustrations descriptive of M. Santos Dumont's experiments were then shown on the screen.

In concluding these remarks on the experiments of M. Santos Dumont I would exhort all those who are at work on the grand problem of the mastery of the air to take to heart one lesson taught by the efforts of the bold Brazilian aeronaut, that is, never to mind failures, and whenever you fail look to the cause. When you have found that you have probably found the road to success, and, like M. Santos Dumont has done, work with enthusiasm, for that is the life-blood of science, as it is of art—in other words it is earnestness of purpose. And when, in the twilight of our imperfect knowledge, you appear at times to meet with insuperable obstacles—then apply to your own special work the inspiring words of a living author who is present with us to-night.

"There are realms of knowledge awaiting the human race, kingships waiting kings, children of earth will ye not rise up and fill these thrones and wear these golden crowns?"

The CHAIRMAN: Were I commenting adequately on the interesting papers we have heard this evening I should feel very sorry indeed for my hearers, for we should not get home till morning I am sure. But the study of aerial navigation by bodies heavier than the air is a study I am particularly interested in; therefore, to me, at any rate, the paper was interesting. Mr. Marriott's remarks were truly interesting and instructive, and they must have been highly appreciated by many, and I am quite sure, ladies and gentlemen, you will be with me in thanking Sir Hiram Maxim, Mr. Marriott and Mr. Eric Stuart Bruce, one and all, for their most interesting papers. With these few words I beg to thank you for your kind attendance and attention here to-night.

A vote of thanks to the Chairman terminated the proceedings.

Digitized by Google

The War Balloon in South Africa.

By Major B. Baden-Powell.

Though unfortunately unable to speak with much experience of the actual working of balloons in action—for I have not been officially employed in this capacity—yet I am frequently asked, having had some practice in military ballooning in times of peace, for my opinions as to its success or otherwise under the conditions of actual hostilities in the Boer War.

South Africa generally happens to be a most unfavourable country for the purpose. First because as a rule it is very open and undulating, so that a general on a hill-top has a wide and extensive view of all around, and there is then comparatively little use for an observer perched in mid air. Secondly, the atmospherical conditions are seldom very favourable. The wind is usually strong, has a way of blowing in very evident gusts, and "devils" or whirlwinds are frequent. I remember seeing a balloon, when close to the ground, caught in one of the latter at Modder River. It was only with the greatest difficulty that it could be kept in hand, and had it not been very ably handled would certainly have been torn to shreds. Shortly afterwards, I believe, a balloon was ripped up under similar circumstances.

As regards the tactical employment of the balloons I am inclined to think, from the limited amount I saw of their working, that they were not utilised to their full advantage. Being ignorant of the orders given or the circumstances governing particular cases, I would not wish to imply blame to individuals, but only to criticise the principles. Usually the balloon was very far from the enemy's position. It is easy to realize how dangerous this form of reconnaissance has become with rifles shooting accurately up to a mile and a half. But something must be risked if we are to obtain good results.

I remember at the battle of Magersfontein, my company was lying down in extended order towards the left of our line. We were perfectly safe from musketry fire, as we lay perhaps two miles from the Boer trenches, which were being shelled by some of our guns close by. The enemy's artillery was practically silenced. Presently, on looking round, I descried our balloon away out behind us about two miles off. Then she steadily rose and made several trips to a good height, but what could be seen from that distance? When a large number of our troops were ranged up within 800 yards of the trenches and many more at all points behind them, what useful information could be obtained by means of a balloon four miles off?

Another point worth criticising in this action was the late hour at which the first ascent was made. As the attack was to have commenced (and, in fact, *did* commence) at dawn, one would have thought it would be most important for the balloon to be actually in mid-air at that moment. Then, at least, one important piece of information could have been gained. It may be remembered that the Boer trenches at Magersfontein were on a gently sloping plain at the foot of some abruptly-rising, rocky kopjes. It appeared, from our point of view, that they were directly at the base of the rocks, and our artillery shelled this locality. Afterwards, however, it transpired that these trenches were mostly a hundred yards or more in advance of the kopjes, so that a large number of our shells must have been wasted on the intermediate ground. Now, an aeronaut ascending fairly close to the position could have ascertained this fact at once.

It is, as a rule, not of much use to adversely criticise actions without suggesting remedies for the mistakes made. I therefore throw forward some hints as to methods which might be pursued.

What might prove to be one of the best means of avoiding as far as possible the dangers of hostile fire would be to make *shorter* ascents. Having carefully decided, while on the ground, exactly what points it was desirable to note, the officer could step into the car and the balloon be allowed to rapidly ascend to its full height. As soon as ever the particular observations had been made, the signal should be given and the balloon rapidly hauled to earth again. Such ascents might often be so quickly carried out that no guns would have time to come into action, and the balloon being almost the whole time moving rapidly it would be well nigh impossible to aim.

If the balloon is fairly close to the enemy's position and rises rapidly to a good height it would float at such an elevation that guns could hardly be elevated sufficiently to hit it. "Pom-poms" will, without doubt, form one of the chief enemies of the war balloon, especially if so delicate a fuze can be made as to burst the shell after penetrating one side of

Digitized by Google

the envelope. That, indeed, would be a terrible affair. But as now made they are incapable of being elevated sufficiently to shoot at a balloon well up.

There is one more matter to call attention to, and that is free ballooning in war. I believe it was never attempted during the campaign, but there were several occasions on which it might have proved of use. Thus, if a balloon had ascended during a favourable wind at Modder River, it should have had but little difficulty in arriving within the precincts of Kimberley, and thus much valuable information obtained of the exact position of the Boers between those places, which information could have been signalled back. I imagine, too, that the Ladysmith balloon could have been the means of obtaining most important details of the Boer positions north of the Tugela, had a free ascent been made during a northerly wind.

Memorandum Concerning the Use of the Captive War Balloon during the Siege of Ladysmith.

By One of the Imperial Light Horse in Ladysmith During the Siege.

The balloon in use at Ladysmith was a captive one, with, I believe, a 1,000-foot cable. For reconnoitring purposes a captive balloon certainly permitted, at Ladysmith, a view of the enemy's laagers and positions behind the heights surrounding the town, a view that would not otherwise have been obtainable.

Should a balloon be used to observe an enemy supposed to be stationary such as a besieging force, it is very important that such observations should be frequent, otherwise serious mistakes may occur, e.g., the observation made by balloon of the enemy's position two days previous to the battle of Lombaard's Kop showed the Boer right to be their weakest point. During the two days previous to the battle, however, the enemy reinforced their right, which, on the day of the fight, was their strongest point.

There seems little doubt that the rotatory motion of even a captive balloon as well as its undulating movements nullify to some extent its use for reconnoitring, as it is almost impossible to get a continued steady view with a glass. Moreover, if the enemy are not moving, it is not easy to determine their force.

What were believed by the balloon section to be two convoys, whose capture was one of, if not the principal cause of the engagement in Long Valley outside Ladysmith, proved afterwards to be only empty waggons.

As regards the danger of a balloon being hit, the Boers made a habit of firing at the balloon at Ladysmith almost exclusively when it was at a short distance from the ground, some 20 to 60 yards elevation on its descent and ascent. It was then more easy to get the range.

At any elevation over 200 yards this seemed impracticable. It is then very difficult to establish the distance of a balloon from a gun, as well as sometimes not easy to obtain the required elevation of the piece.

The balloon at Ladysmith was hit three times, each time near the ground. The Boers too, had the advantage of having the gun they usually used against the balloon posted on Umbulwana, a hill nearly 1,000 feet high.

During the earlier part of the siege, the balloon made ascents almost daily.

After the siege of Ladysmith, Lord Roberts still continued to use balloons when making his main advance on Pretoria.

The Banquet to M. Santos Dumont.

The banquet given in honour of M. Santos Dumont by the Aero-Club of the United Kingdom at the Whitehall Rooms on November 25, may be described as a brilliant success. Major-General Lord Dundonald occupied the chair. Amongst the large and distinguished company present were the Brazilian Minister, Lord Suffield, Colonel Templer, Director of Military Ballooning, the Hon. C. S. Rolls, Mr. R. W. Wallace, K.C., Chairman of the Automobile Club, the Hon. J. S. Montague, M.P., Mr. Eric Stuart Bruce, Honorary Secretary of the Aeronautical Society of Great Britain, Sir C. Champion de Crespigny, Professor John Perry, F.R.S., President of the Institute of Electrical Engineers, Sir J. Crichton Browne, Major F. C. Trollope, Professor D. S. Capper, Sir V. Kennett Barrington, Colonel R. E. B. Crompton, R.E., Sir Norman Lockyer, Signor Cardoso de Oliveira, First Secretary to the Brazilian Legation, Signor

Digitized by Google

J. C. Rodriguez, M. Chermont, the Brazilian Consul, Mr. F. H. Butler, Mr. E. P. Frost, Mr. Paris Singer, Dr. Boveston Redwood.

Letters of regret at inability to be present were received from Sir W. Crookes, and Sir D. Solomans.

After the loyal toasts the Chairman proposed the toast of "The Republic of the United States of Brazil," and in reply expressed his pleasure in seeing that his distinguished countryman had alighted in this country. The Brazilian guests would always remember it with gratification and pride. Whatever might be the future prospects of aerial navigation, he was confident that the name of M. Santos Dumont would live in its history as the man who had navigated a flying ship and straightened its course against and across the wind. (Cheers.)

Mr. R. W. Wallace, K.C., in proposing "The Naval and Military Forces of the Empire," remarked that ballooning was peculiarly adaptable to military service as a means of observation. He considered that M. Santos Dumont's airship would be of considerable use in war. The time would probably come when we should have not only our Foot Guards and our Horse Guards, but our Aerial Guards as well. (Cheers.)

Sir C. Champion de Crespigny responded for the Navy.

Colonel Templer, who replied on behalf of the Army, remarked that when M. Santos Dumont accomplished his journey round the Eiffel Tower the weather was so unpropitious at Aldershot that it was believed to be impossible for him to do it. What made the feat so remarkable was that M. Santos Dumont actually rounded the Tower with the wind, came up against the wind and got to his point in the time. (Cheers.)

The Chairman in proposing the health of the guest of the evening remarked that they were there that night to celebrate an event in the history of the world. To science there were no geographical boundaries, or differences either of language or of customs. (Hear, hear.) The man who was victorious over natural obstacles was a friend to all humanity, but none the less were they pleased that their illustrious guest belonged to a nation with which the British nation enjoyed intimate and cordial friendship. For the past century aeronautical students had tried to solve the problem of how to steer a balloon against the wind, and a great amount of brain power had been devoted to the question. It had been left to M. Santos Dumont to illustrate by his remarkable and daring feat the solution of the problem. He felt sure that their guest was far too generous a man to disregard the efforts of his predecessors, and that he would give the credit which was due to that far-seeing and illustrious Frenchman, Henri Giffard, who, in 1851, tried to navigate a cigar-shaped balloon by means of a steam engine against the wind. He would also recognise that his success much depended upon the advance in the construction of light and powerful motors.

It was unnecessary to dwell upon the experiments of M. Santos Dumont. Having previously risked his life in experimental machines, having built his five airships, having been suspended from the top of the Trocadero Hotel, nothing daunted, he accepted M. Deutsch's challenge of £4,000 to the aeronaut who could make the journey of four miles from St. Cloud to the Eiffel Tower and back in half an hour. Their guest obtained the prize, passing round the Eiffel Tower at a height of 1,000 feet above the ground and within a radius of 40 yards, and completed the journey within the specified time. He had, with generosity, handed over the money to the poor of Paris and to those who had helped him in constructing his airship. The feat was a milestone on the onward march of the world. They admired the man who accomplished it for his successful scientific endeavour, for his splendid courage; and he would assure him that not only those in that room, but the whole British people earnestly hoped that his future efforts might be crowned with success. When the names of many of those who had occupied prominent positions in the world should have been long relegated to oblivion, there was one name that would, at all events, be remembered, that was that of M. Santos Dumont. (Cheers.)

When M. Santos Dumont rose, the enthusiastic reception accorded to the aeronaut who has "given wings to the petroleum motor," will be long remembered by those who had the privilege to be a guest that evening. In replying, M. Santos Dumont thanked the promoters of the Aero-Club for having kindly conferred on him the title of honorary founder member of the Aero-Club of the United Kingdom. He reminded the company that he was, for the moment, the only member of the Aero-Club. (Laughter.) He hoped, however, that he should not occupy this solitary position for long. The sympathetic reception he had met with in London would encourage him to return

Digitized by Google

to London in a few months' time, after his aerial voyage from France to Corsica. (Cheers.) He should then be happy to make some trials in a steerable airship above London. (Loud cheers.) In drinking to the health of the Earl of Dundonald, who did them the honour to preside at this inaugural banquet, he drank to the health and prosperity of the members of the Club present, to those who were absent, and also to the great British nation, which, after gaining the empire of the seas, already aspired, thanks to their initiative to the empire of the air. (Loud cheers.)

Mr. C. F. Rolls replied to the toast, proposed by M. Santos Dumont, and said that a common idea was prevalent that the sport of ballooning was attended with great danger; but during the time the Paris Exhibition was open 600 ascents had been made without a single mishap. (Cheers.)

The toasts of "the visitors" was proposed by Major F. C. Trollope and responded to by Sir J. Crichton Browne. The toast of "the Chairman" concluded the proceedings

Meetings of the Permanent International Aëronautical Commission.

TRANSLATED BY H. A. B.

At the meeting, at the Institute, of the 18th of July, the Commission carried by acclamation, Commandant Renard's proposal to forward their congratulations to M. Santos Dumont on his remarkable experiments of the 12th and 13th of July.

The sub-committee of "Asphyxiation by Impure Hydrogen" reported that the experiments on animals at Chalais confirmed the action of impure gas as a cause of paralysis.

The sub-committee of "Aeronauts' Licenses" reported they were concluding the formulation of a scheme which, while respecting the liberty of aeronauts, would liberally safeguard the public.

M. Moureaux, of the Magnetic Staff at Park St. Maur, had laid before the sub-committee of "Balloon Bearings" a method of magnetically locating the balloon up to about 25 kilometres, by measuring, at 30 seconds, the declinations and inclinations. Height does not affect this method of measurement.

M. Le Comte de la Valette's method of geographical determination by a recognition of characteristic figure-types of the country, is to be called "Topomancy;" the figure-types observed and represented in the dictionary will be railways, watercourses, roads and forests in groups as they occur, and for France there will be from 2,000 to 2,500 observations which will furnish a determination or map of locality at about every 10 kilometres. The signs made use of to represent the above figure-types, railways, etc., in these determinations, are few and simple.

At its latest meeting the Permanent International Aeronautical Commission adopted the scheme of regulations sent up to it by its sub-committee of "Aeronauts' Licenses," and it listened to the legal report on these regulations of M. Laurens de la Barre, advising counsel to the sub-committee.

The object of the sub-committee was to induce a number of Governments to uniformly regulate aerial navigation on a basis liberal to aeronautical development. Controversies as to the national or international character of the resolutions have been met by M. Laurens de la Barre by his dividing the resolutions of the sub-committee into two schemes, the one of a proposed *international character* to embody principles, the other of a *national character*, which is offered to other countries as a type of complementary regulations.

The Police and Public Safety Regulations in force in every country have been reserved; in any country in which his license confers it, a licensed aeronaut is to have equal rights with the licensed aeronauts of that country—this is to be a general measure; in conclusion, the obligatory character of a license, for the contracting States, has been defined.

The International Balloon Ascents.

In September, October and November, international balloon ascents took place in Austria, France, Germany, and Russia. The most noteworthy results appear to have been attained at M. Teisserenc de Bort's Observatory, at Trappes, where the highest altitudes were recorded. On September 5th, in a night ascent, a height of 14,178 metres was reached; the temperature on the ground was 5°.6 C, at the extreme height it was —55°.2 C. On October 3rd, in the night ascent, the height was 14,500 metres. The temperature on the

Digitized by Google

ground, 8°.1 C, at the extreme height —58° C. In the day ascent, the height was 13,150 metres, the temperature on the ground 11°, at the extreme height —53°. On November 7th, in a night ascent, the height was 13,200 metres, the temperature on the ground was 2°.4, at the extreme height —62°. At Berlin, on the same day, an altitude of 12,010 metres was attained. The temperature on the ground was 6°.5, at the extreme height —58°.4. A manned balloon leaving Berlin attained a height of 1,100 metres, and experienced a wind velocity of 80 kilometres an hour.

It is officially announced that the ascents of manned and unmanned balloons will be continued during 1902, the dates proposed being the first Thursday in each month excepting January, when the second Thursday is selected. A meeting of the International Aeronautical Committee will be held next year in Berlin, when questions relative to the ascents will be discussed.

NOTES.

The Aeronautical Exhibits at the Recent Automobile Exhibition in Paris.—At the Automobile Exhibition held at the Grand Palais, in Paris, in December last, there were several aeronautical exhibits evidencing the alliance which is growing up between automobilism and aeronautics. Prominent amongst the objects of aerial interest was M. Deutsch's steerable balloon the "Ville de Paris" in the Grand Nave. A trial of this balloon is promised for next spring. In the Cupula Hall of the Palais, was the car of Colonel Renard's historical balloon. The Aero-Club illustrated by pictures the nature of the attempt to traverse the Mediterranean by Count de la Vaulx, and the crossing of the Alps by Mr. Henry Deutsch. An exhibit of great scientific interest was the barometric, thermometric and hygrometric records of observations made at great altitudes with ballons-sondes by M.M. Besançon and Hermite during the past 10 years. In an article on these historic records by M. Aimé, in the *New York Herald*, he points out that a glance at some of the themometric charts on view was sufficient to produce a cold shiver. The record is held by the ascent of the aerophile on February 18th, 1897, in which the memorable temperature of —66 degrees was registered. Though human aeronauts can never expect to experience the temperatures registered by the recording instruments of the ballons-sondes, as the limit to human endurance to the conditions of rarefaction seems to be some seven miles, yet aeronauts who make high ascents experience sufficiently low temperatures to make the heating apparatus of M. Jacques Balsan very valuable to aeronauts. As M. Aimé points out in this, heat is obtained without fire, and consequently danger by means of this well-known action of water on quick lime. The constant existence of currents in diverse directions at different levels of the atmosphere is manifested by the ascents of the unmanned balloons. In the words of M. Aimé, who has for years pointed the possibilities of aerial navigation by means of diverse currents, "The winds are the moving side walks of the atmosphere, which offer us gratuitously their platforms superposed and crossed ad infinitum. Instead of continually proceeding against the currents of the air, it will be economical and indispensable to take advantage of them as much as possible, according to Bacon's principle. One triumphs over nature only by obeying her laws."

A well-arranged and instructive exhibit was that of the Aeronautic Club, which showed some very striking examples of progress in the accessories of balloons; for instance, there was a primitive car illustrating the condition of balloon industry 10 years ago. Beside this was the modern car containing such luxuries as seats, drapings, and carpets. There was also an exhibition of the instruments of precision which are indispensable to every aeronaut, including a map of the terrestrial region below the balloon on its movable tablet. A glance at this map and at the earth tells the aeronaut the direction of the wind at every instant. Other objects of interest were M. Bordé's statoscope which records the least upward or downward movement of the aerostat, and his aerial field glass which permits balloonists to observe the horizon accurately. Two popular exhibits were:—1. The chronograph used to take the time of the memorable journey of M. Santos Dumont round the Eiffel Tower on October 19th. 2. The compass needle suspended to the car of the Santos Dumont No. 6.

M. Santos Dumont's Plans.—The next item in M. Santos Dumont's programme is a trip to Corsica from Monte Carlo in his new

Digitized by Google

navigable balloon No. 7. The new airship is 50 yards long, being 10 yards longer than the No. 6. The trials will commence directly the shed which is being constructed for him by the Prince of Monaco on the sea shore is completed. The gates of this shed are 50 feet in height, and the trees on the boulevard in front have been removed to allow of free exit for the balloon. The hydrogen plant has been installed. When fully equipped the No. 7 balloon will eventually have two motors, fore and aft, of 45-horse power each. During the first few weeks of his stay in the south, M. Santos Dumont will make several trips over the Bay of Monaco in the No. 6 balloon. It is rumoured that at first, with the No. 7 balloon, the old motor of 20-horse power will be used. The advantage of using the lighter motor with the new and larger balloon is that it could carry an ampler quantity of petroleum. The 20-horse power motor would propel the airship at a fair speed. The weight of the 45-horse power motor already built is 175 kilogrammes. It is, however, to be hoped that M. Santos Dumont will, at an early date, avail himself of the greater horse power so that he may be able to combat higher wind forces than he has hitherto done, and thus show a still more decided advance in navigating a balloon against the wind than has been indicated in his experiments this summer. It is now far more important for the development of aerial navigation to institute a series of quantitative experiments in moderate winds even if only short journeys are involved than to undertake long journeys in calm weather, the possibilities of which will not be doubted after M. Santos Dumont's recent experiments. M. Santos Dumont has promised to return to London after his trip to Corsica, and on his navigable balloon to make a journey round St. Paul's Cathedral, though he somewhat dreads the telegraph wires. Whether or not he actually performs this aerial journey, his second visit to London will be most welcome.

The £40,000 Prize.—The authorities of the St. Louis World's Fair have announced that they have decided to offer to aeronauts next year a prize of £40,000 for the successful working of a steerable balloon. This tempting offer will go far to intensify the aeronautical movement that is ushering in the twentieth century, and the present year should be one of the most intense interest to the aeronautical student. It is to be hoped that some of the airships that are being built in this country will be completed in time to take part in the St. Louis competition.

Aerial Wireless Telephone.—The *Daily Mail* reports that M. Ducretet has invented an apparatus enabling aeronauts to remain in communication in the air. The invention is a wireless telephone which is carried in the balloon and which dispenses with the metallic connection with the earth. M. De Fonvielle has pointed out that if the instrument were fitted to a steerable balloon the scientific communion on the Eiffel Tower would be able to transmit orders to the aeronaut directing him to go east or west, to rise or to descend, at pleasure.

Aerial Currents.—The advantage of selecting favourable aerial currents in balloon voyages was exemplified in one of Mr. Charles Rolls' recent ascents. On September 24th, 1901, he ascended from the Crystal Palace in company with Mr. Frank Butler and Miss Butler in a very gentle breeze. Starting, at 4 p.m., in the direction of London, according to the clouds and smoke, the aeronauts expected to sail into the heart of London, where they would have had to descend owing to their shortness of ballast, and they were just preparing for a chimney-pot descent when they found a contrary current which took them nearly over the Palace again, enabling them to find a small piece of green (called Lee Green), in which they dropped just before dark, having used all their ballast.

The Attempt to Cross the Mediterranean in a Balloon.—Although Count De La Vaux and his companions failed to carry out their project of crossing the Mediterranean in a balloon, the voyage was by no means without interest, having lasted forty-one hours and five minutes, thus beating all records for the length of time in the air. The experiments with regard to the possibility of deviating the course of the balloon were absolutely conclusive, and there is now no doubt that with the Hervé apparatus it is possible to remain in a balloon over the open sea for several days. Count Henri de la Vaux intends to renew the experiments with still more perfect apparatus.

The Scheme for Crossing the Sahara in a Balloon.—Captain Debureau, of the French engineers, has devised a bold scheme for the crossing of the Sahara in a balloon.

Digitized by Google

He has made a special study of the prevailing wind in that region, and according to his calculations, a balloon starting from the south-west of Tunis might be borne at the rate of 20 kilometres an hour to the south-west of the Sahara in about five days. Captain Debureau proposes to make arrangements for a journey taking 12 days; and as a remedy for the gradual loss of gas during the trip he would use the ordinary guide rope and would carry a reservoir containing 1,200 litres of water which would work automatically. By means of an ingenious contrivance a certain amount of the water accumulated would be let out whenever the balloon approached the ground, and relieved of the weight which had drawn it down, the balloon would ascend, until a further escape of gas again sent it towards the ground.

The Balloon in War.—Mr. Eric Stuart Bruce will read a paper before the Society of Arts on the subject of the Balloon in War on Wednesday, February 19th, 8 p.m. General Sir George Higginson, K.C.B., will take the chair.

Foreign Aëronautical Periodicals.

On this list a selection of some of the most notable articles is given.

L'AÉRONAUTE (Paris).

October, 1901.—Projet d'Aérostat Long-Courrier.

November.—Séance de 24 Octobre, 1901.—Les Expériences de M. Santos Dumont: M. E. Aimé.—Procès-Verbal de l'Assemblée Générale Extraordinaire du 14 Novembre.

December.—Conférence de M. Armengaud sur les Expériences de M. Santos Dumont.

L'AÉROPHILE (Paris).

October, 1901.—Portraits d'Aéronautes Contemporains: Maurice Mallet, Georges Besançon; Une Chaudière à Vapeur d'Ether, Henry de Graffigny; Automobilisme Aérien, A Sallé; Tourisme Aérien, Maurice Farman; Ballon Dirigeable à Corps Rigide, Frédéric L'Hoste.

REVUE AMPÈRE (Paris).

November, 1901.—La Conférence de M. Emmanuel Aimé fait sous la Présidence de M. Santos Dumont.

December.—Santos Dumont à la Conférence Ampère.—La Traversée de la Manche en Ballon.

ILLUSTRIRTE AËRONAUTISCHE MITTHEILINGEN.

Ein Ballonaufstieg bis 10,500 m., von A. Berson und R. Süring.—Die Militärluftschiffahrt in Spanien, von H. W. L. Moedebeck.—Die Zivil— und Strafrechtliche Haftung des Luftschiffers, von Rechtsanwalt Dr. G. Rosenberg.—Magnetische Messungen im Ballon, von Dr. Hermann Ebert.—Beiträge zur Mechanik des Fluges und Schwebenden Falles, von Dr. W. Köppen.

Notable Articles.

1901.

Oct. 3. *New York Herald.*—"Mr. Stone's Screw Aerostal."
4. *New York Herald.*—"Her Kress' Catastrophe."
8. *Globe.*—"The Art of Flying."
14. *Standard.*—"By Balloon to Africa."
19. *The Pilot.*—"The Prospects of Flight."
22. *Times.*—"M. Santos Dumont's Balloon."
22. *Daily Telegraph.*—"A Chat with M. Santos Dumont."
22. *Globe.*—"Soaring Flight."

Nov. 5. *Times.*—"The Deutsch Prize."
9. *The Golden Penny.*—"Navigating the Air."
23. *Navy and Army Illustrated.*—"Italian Military Ballooning."
23. *Daily Graphic.*—"M. Santos Dumont in London."
27. *Pall Mall Gazette.*—"Round about the Great Balloon."
30. *Illustrated Mail.*—"How it Feels to Steer an Air-Ship."

Dec. 4. *The Sketch.*—"Scientific Kite-Flying."
7. *Black and White.*—"Shall We Ever Fly?"
9. *Nature.*—"Scientific Ballooning."
21. *New York Herald.*—"Scientific Aeronautics."

Digitized by Google

Applications for Patents.

(Made in October, November, and December.)

Compiled by Bromhead & Co., 33, Cannon Street, London, E.C.

19,594. October 1. Harry Clarke Calloway. **An Improved Aerial Apparatus.**

19,903. October 5. James Blygh Wayman Maunder and Alexander Schanschieff. **Improvements in Air-Ships.**

19,995. October 7. Eugene Lincoln Swingle. **A New or Improved Aeronautic Apparatus or Machine.**

20,008. October 7. Robert John Baldrey. **Aerial Navigation by Means of Bird Traction.**

20,715. October 16. Louis Fillion. **Manageable Balloons.**

21,099. October 21. Augusto Severo. **Improvements in Balloons or Apparatus for Aerial Navigation.**

21,948. October 31. Joseph Cohen and James Little Blain. **Improvements in Aerostats and Navigable Balloons.**

21,977. October 31. Carl August Richard Geilich. **Improvements Relating to Apparatus for Aerial Navigation.**

22,456. November 7. Anton Wiezera and Lewis Wells. **Improvements in Flying Machines.**

23,566. November 20. Samuel Franklin Cody. **Improvements in Kites and Apparatus for the Same.**

23,730. November 22. Edward Minty and John Donkin. **Improvements in Aerial and other Ships.**

24,571. December 3. Eugene Lincoln Swindle. **A New or Improved Flying Machine.**

25,313. December 11. Pierre Lirelli and Henri Myara. **Improvements in or Relating to Air-Ships.**

Digitized by Google

20.5
245

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH
AUG 4 19

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain.

By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 22. APRIL, 1902. VOL. VI.

All Rights Reserved.]

Contents.

PAGE.

NOTICES OF THE AËRONAUTICAL SOCIETY 21

SCIENTIFIC BALLOON ASCENTS 21

THE INTERNATIONAL KITE COMPETITIONS 21

GENERAL MEETING OF MARCH 11, 1902—

1. THE POSITION OF THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN IN 1902 22

2. THE ST. LOUIS EXHIBITION AND AIRSHIP TOURNAMENT. COMMUNICATION FROM THE DIRECTORS OF THE ST. LOUIS EXHIBITION 22

3. THE DEVELOPMENT OF AERIAL NAVIGATION IN GERMANY. BY MAJOR W. L. MOËDEBECK.—THE ENGLISH TRANSLATION BY HELEN E. BRUCE.—DISCUSSION 24

4. PHOTOGRAPHY FROM A BALLOON. BY GERTRUDE BACON .. 28

5. SOME FURTHER NOTES ON THE BARTON AIRSHIP. BY DR. F. A. BARTON.—DISCUSSION 30-38

APPLICATIONS FOR PATENTS 38

LONDON:

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL :—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G. F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901.

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated),

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

THE AËRONAUTICAL JOURNAL.

APRIL, 1902.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road,
Kensington, London, W.

NOTICES
OF
The Aëronautical Society.

At a meeting of the Council held at the Society of Arts, John Street, Adelphi, on March 11th, 1902, the following gentlemen were elected members of the Society:—

Mr. MARK BARR.
Mr. THOMAS FRAZER.
Mr. WILLIAM GUY.
Mr. HERBERT FETHERSTON LLOYD.
Mr. F. N. MRAZSEK.
Mr. ALEXANDER SMART.
Mr. S. LAWRENCE SWINBURNE.
Mr. PETER WILLIAMS.

The next General Meeting of the Aëronautical Society of Great Britain will take place in July, particulars of which will be duly announced.

ANNUAL SUBSCRIPTIONS.

The Annual Subscriptions to the Aëronautical Society were due in January last. Those Members who have not yet paid their Annual Subscriptions are requested to forward them to the Honorary Secretary, 19, Campden House Road, Kensington, London, W. The attention of those Members is called to Rule IVA., which states that the privileges of Members extend only to those who have paid their subscriptions for the current year.

SCIENTIFIC BALLOON ASCENTS.

It is the intention of the Council of the Aëronautical Society to arrange some Balloon Ascents for strictly scientific purposes, and an ascent will be made this summer for the purpose of investigating the direction, strength, and thickness of aerial currents encountered during the voyage, a research which is of paramount importance to the progress of Aerial Navigation, whether its ultimate solution is to be accomplished by the body that is heavier than air or lighter than air. The Council are fortunate in having secured the co-operation of so eminent a meteorologist as Mr. Charles Harding, F.R.Met. Soc., who has had past experience in scientific investigations from balloons, and who has kindly consented to take the necessary observations.

Due notice will be given to Members of the Society as to date and place of the ascent.

INTERNATIONAL KITE COMPETITION.

There will be an International Competition for the Highest Kite Flight under the auspices of the Aëronautical Society of Great Britain, in 1903. Further particulars will be shortly announced.

ERIC STUART BRUCE,
Honorary Secretary.

Digitized by Google

GENERAL MEETING.

The second meeting of the Session of the Aëronautical Society was held at the Society of Arts, John Street, Adelphi, on Tuesday, March 11th, 1901. Sir Hiram Maxim in the chair.

The Honorary Secretary read the Minutes of the last meeting and also a letter received from the German Ambassador expressing to the Council his great regret that, owing to a previous engagement he was prevented from being present on the occasion of the present meeting.

The CHAIRMAN: Miss Pilcher, who is an honorary member of our Society and sister of Mr. Percy Pilcher, who lost his life in making experiments with a view of navigating the air, has presented to our Society all the photographs, note-books, lantern slides and apparatus which the late Mr. Pilcher left, and I suggest a vote of thanks be sent to Miss Pilcher for her kindness in this direction.

We have received a communication from the St. Louis Exhibition which our Secretary will now read

The Honorary Secretary then read the following communication from the Directors of St. Louis Exhibition:—

It has been fully and finally determined on the part of the officers of the Exposition to have a tournament of airships and an aërostatic congress at the World's Fair in 1903. In order to stimulate inventors along this special line of experiment, prizes aggregating 200,000 dols. will be offered for the most successful contestants. In view of the remarkable results attained by M. Santos-Dumont at Paris last year, when he made a thirty-minute trip around the Eiffel Tower, having his airship under control during the entire journey, the coming tournament is in the line of progress. It is the desire of the officers to achieve better results than those of Santos Dumont, and for that reason the prize is made a most liberal one.

When the classification of exhibits was prepared by Mr. Frederick J. V. Skiff, Director of Exhibits, he included in the Department of Transportation, in Group 77, four classes of exhibits relating to aërial navigation. Class 481 relates to balloon construction; fabrics, varnish, cars, valves, netting, cordage, appliances for stopping balloons, such as anchors and grapnels, the generation of hydrogen and other light gases, captive balloons. Class 482 relates to aërial voyages, the use of balloons for the study of the atmosphere, air currents, clouds, temperature at great heights, optical phenomena, etc., drawings, maps of journeys, diagrams, photographs. Class 483 relates to military ballooning; military captive balloons and their accessories, winding drums, transport wagons, apparatus for inflation. Class 484 relates to aërial navigation, dirigible balloons and guiding apparatus, flying machines, screw propellers, aëroplanes and parachutes. The fourth class mentioned is the one having a particular public interest at the present time.

It was early recognised by the officers of the Exposition that the navigation of the air is one of the great problems for scientific solution, and that this Exposition would not fulfil its duty to the world unless it lent its encouragement and furnished an opportunity for those who are skilled in this difficult science to demonstrate the results of their endeavours.

The experiment of M. Santos-Dumont has set the inventors to thinking anew upon this most interesting problem, and the tournament at the coming World's Fair will be one of the most novel in history. A cablegram from London says that Sir Hiram S. Maxim, the American inventor, has expressed himself as being willing to expend 100,000 dols. in addition to the large sums he has already laid out in experiments in aërial navigation to win in the coming contest, if assured that the prize will be as large as announced. In reply to this, President David R. Francis, of the Louisiana Purchase Exposition, is quoted as follows: "Sir Hiram Maxim will receive all the assurance he desires when the committee on aërial experiments has crystallized the plan for the contest. If he abides by the conditions of the competition and invents an airship that will obey the directions of an operator in mid-air, as well as develop speed, he will be entitled to be adjudged as a real contestant.

"The total sum of 200,000 dols. has already been set aside by the executive committee for the purpose of defraying the expenses of the proposed aërial tournament. Of this sum 100,000 dols. will constitute the award for the successful operation of a craft in the air, 50,000 dols. will be devoted to premiums for races between airships, and 50,000 dols to defray the expenses of the competition. We have opened correspondence with noted experts in aërial science, and the entire matter of suggestion with reference to the management of the contest will come from that authority."

Secretary Water B. Stevens, of the Exposition Company, says: "The recommendation

Digitized by Google

of Director of Exhibits Skiff on the subject of the airship contest has been unqualifiedly endorsed by the entire Executive Committee. Nothing in the way of a suggestion for an exposition feature has received such immediate and strong approval."

The Executive Committee of the Exposition has appointed as a sub-committee in charge of the tournament and congress, Mr. Charles W. Knapp, proprietor of the "St. Louis Republic," and Nathan Frank representing the "St. Louis Star." This sub-committee has invited Prof. S. P. Langley, Secretary of the Smithsonian Institution of Washington, D.C., and Mr. Octave Chanute, of the Western Society of Engineers at Chicago, distinguished scientists, who have devoted much attention to aërostatics, to visit St. Louis for a conference upon the subject of the aërial tournament and aërostatic congress at the World's Fair. At this conference rules for the event will be determined, and a proper division of the 200,000 dols. will be decided upon. It is also probable that they will recommend for appointment a chief of the aërostatic display. The following is the letter addressed to Prof. Langley and Mr. Chanute by Director of Exhibits Skiff:

"At a meeting of the Executive Committee of the Louisiana Purchase Exposition Company, it was determined to recommend to the general Board of Directors of the Corporation that a congress of aërostatics be called and an aërial tournament be held during the International Exposition at St. Louis in 1903, and a large sum of money was tentatively appropriated to defray the expenses of the congress and tournament and to cover the prizes that it is intended to offer.

"The President of the Exposition Company, who is Chairman of the Executive Committee, appointed a special committee of two on the plan and scope for the congress and tournament, the members of the committee being Mr. Charles W. Knapp and Mr. Nathan Frank. At the request of this special committee and with the approval of the President, I beg to ask if it will be convenient and agreeable to you to visit St. Louis at an early date for the purpose of conferring with this special committee?"

The announcement that such a liberal sum would be set aside for the encouragement and experiments in aërial navigation has stirred up a very lively interest in the science, and many inquiries have been received by mail and wire at Exposition headquarters. Secretary Stevens reports that it is possible there will be at least 100 entries representing not less than ten countries.

The CHAIRMAN: It is not strictly true that I offered to spend a hundred thousand dollars on experimenting for the St. Louis Exhibition. I saw it in the papers, and they have written to me on the subject, and I may tell them no one had been authorized to make such a statement. Nevertheless, I may spend some large sum of money in experimenting before that time, but I would say that I have already written to the Committee and have told them that as the Exhibition takes place in a little more than a year, and as no flying machine is yet in existence, I think there is very little hope that anyone will have one at that time. We must remember that these experiments have been going on now for a great number of years, and nobody as yet has made a machine, and to say we are going to make one and have it ready and tried and assured of its success before the Exhibition of next year is making a statement that I do not think we shall be able to fulfil. Then, again, if anyone in England should make a successful flying machine they might put it to a very much better use by lending it to our own Government for reconnoitring the position in South Africa. I think the Exhibition at St. Louis will come to be a Balloon Exhibition, especially as I understand there is a good deal of wind there. But one good thing will certainly result from the Exhibition: it will turn attention in the direction of flying machines and balloons, and it may lead to the development of matters which in the immediate future will be very useful, and although we may not look for a successful flying machine or successful navigation of the air at the St. Louis Exhibition, I feel sure it will turn attention to the subject and will be very beneficial to the study of navigating the air in the future.

The SECRETARY: I may mention that I have been informed by the representatives of the Exhibition in this country that they will kindly furnish me from time to time with statements of all the arrangements of this Exhibition, so that members of the Society who wish to send navigable balloons or take part in the other exhibits will be able to get all the information they need. I shall be happy to put any knowledge I have at their disposal. I myself, as Secretary of the Society, hope that members will send several exhibits to this Exhibition, and, in fact, to every International Exhibition that is held, and I think even if a great advance is not made with the airships

Digitized by Google

there may be, all the same, a very interesting race. About the exhibits, I think we certainly might make a large show amongst our members in these various groups that I have mentioned, and there should not be the same dearth of Foreign Exhibits as in the case of the Paris Exhibition. In the case of the Paris Exhibition there were only two aëronautical exhibits belonging to foreign exhibitors, all the other exhibits being exclusively French. One of these was my own, being the electric signalling balloon, and the other was from the Russian Government. I hope that will not be the case at the St. Louis Exhibition. I should now like to say one word about the position of our Society in 1902. Facts show how satisfactory it is. 1. Financially as shown by the balance-sheet recently put into the hands of our members. 2. By the increase of our members. 3. By the co-operation of so many distinguished aëronautical authorities in all parts of the world. The wide sympathy with our efforts to promote the advance of aëronautics has been specially evidenced within the last 12 months, no less than three foreign countries having been represented in the paper read at our general meetings—France, America, and Germany.

We still have to regret the absence of our President, the fruits of whose earnest labours for the promotion of aëronautics in this country we are now reaping in the prosperity of our Society, but we hope that before Coronation Day peace may have been restored, and that we may have welcomed him in our midst.

The CHAIRMAN: Major Möedebeck, who wrote the principal Paper of the evening, is not present to-night, but our Secretary will read his Paper, and I am quite satisfied that he will do it quite as well as the author would have himself. We are indebted for the present English translation to Helen A. Bruce.

The Development of Aerial Navigation in Germany.

BY MAJOR W. L. MÖEDEBECK.

I feel it a great honour to read a paper today before you, the oldest Aëronautical Society in the world, with whom I have had amicable relations for now many years. In accordance with the friendly suggestion of your Honorary Secretary, Mr. Eric Stuart Bruce, I propose to bring before you a short outlook over the development of aëronautics in Germany, which I hope will offer to many of you new and unknown facts.

When in 1783 the wave of enthusiasm beat high over the discoveries of Montgolfier and Charles in Paris, the new interest took deep root in the capitals of the numerous small States which in those days constituted Germany. As soon as the principle of an air balloon was understood, the German scientists had hastened to repeat the experiment of Charles for their own people, only on a smaller scale. But their first curiosity once satisfied, the crowd grew discontented, because they had not also seen human beings ascend with the balloon. The Frenchman Blanchard first satisfied this craving amongst us, and everywhere when he ascended in Germany, at Frankfurt a/Main, Hamburg, Aix, Nuremberg, Berlin, Breslau, and Leipzig, he was fêted and honoured. Numerous writings, prints, and memorial medals bring home to us the profound impression Blanchard's air voyages produced on the populace. And at the same time there now awoke the patriotic consciousness of the German peoples. Joseph Maximilian Freiherr von Lüttgendorf, at Augsburg in 1786, was the first German who made a gas balloon, and he fitted it with various little original arrangements. When these first German balloons were to ascend at Augsburg there were extravagant preliminary rejoicings, but the experiment failed miserably on account of the difficulty of filling balloons in adverse weather conditions. Poor Lüttgendorf was unmercifully mocked about it. People were not then sufficiently enlightened on the subject to know that there had always hitherto been this difficulty in filling balloons in unsuitable weather, even in France, and it was only finally overcome by energy, zeal, and experience. The populace had been spoilt in this matter, for it so happened that Blanchard had each time succeeded in this technicality, and so the people were incapable of estimating poor Lüttgendorf's misfortunes rightly.

But I must turn for a moment to Alsace, then under French rule. There at Strasburg, in 1784, two fine Montgolfiers were made, one by Adorn, a mechanic, and the later one, beautifully painted, by Degabriel and Pierre. Also the best book on the "History of Aëronautics," by Kramp, was published in German, at Strasburg: it is now a priceless authority; and at Strasburg, too, a Wurtemberg artist, Enslin, first made the many-shaped grotesque goldbeater's skin balloon figures now only made in Paris. All these historical facts, established by documents, have hitherto been overlooked by writers on aëronautics, who have kept their eyes fixed only on Paris, and

Digitized by Google

have collated their histories from the well-known and widely-circulated book written by Faugas de St. Fond. In this work misleading statements as to the course of well-known balloon journeys are circulated, and much that is of interest is passed over in silence.

As is known, within a few years of the invention of the Montgolfier, aëronautics fell into disrepute owing to the recognition of the fact that with the means then at disposal it was impossible to make a steerable balloon. Following on Robertson's groundless statements about atmospheric electricity, the first recorded scientific balloon ascents took place under the auspices of the French Academy of Sciences; these were followed up at Berlin, in 1804, by various scientific ascents of Professor Tungius.

We must now pass over for Germany a long period of years barren of aëronautical incident until the war of 1870-71. Then help came to us from you! Your famous aëronaut, Coxwell, came to Germany with his balloon material, and initiated us into the technical secrets of a balloon service. But the improvised division which sent up a balloon once before Strasburg did not show itself equal to what had been claimed for it, and was not utilised at the siege of Paris. The prevailing opinion in Germany after the war was against the formation of a military aëronautical service, and a wave of hostile popular feeling showed itself when the Drs. Wölfert and Baumgarten carried out various experiments at Charlottenburg with a gas balloon. The next event was the formation in 1881 of the German Society for the advancement of aërial navigation. The first object of this Society was naturally to have and use the balloon; but, as it was not easy to get the necessary means, it at first contented itself with the clearing up of various aëronautical difficulties in so far as the limited aëronautical experience of its members would allow, and with the carrying on of a lively propaganda on behalf of the formation of a military balloon service. The Society also brought out from the year 1882 till 1900 a monthly journal. There is no doubt one must ascribe it to the efforts of this Society for the establishment of a balloon service that in 1884 the War Minister decided to form a balloon detachment, to-day developed into our balloon battalion. But for the Society, this separation of the military interests seemed as though it would be fatal, for it was gradually borne in on the members that now it would be long before they could have a balloon

Luckily, just at this moment, the science of meteorology began to arouse a deep interest in Berlin. Its new representatives decided to take up a Society, and with it a new scientific ideal in the pursuit of investigation in the upper atmospheres. Thus, through the new general interest, the Aëronautical Society now became a union of the practical active balloon officers and of the theoretical and cultured meteorologists who had preceded them. It contained only one aviator, but he was world-known, Otto Lilienthal, the inventor of soaring-machines—now a school in itself—and he fell a martyr to his experiments. It had at this time but few members, but these few had their object steadily before them, and they were men who could devote themselves to a cause undertaken. Names such as those of Bezold, Assmann, Berson, Gross, and Süring speak for themselves. But, after all, what would they have attained without the supreme interest and munificence of His Majesty the German Emperor? The German Society for the Advancement of Aërial Navigation owes to His Majesty alone the fulfilment of its wish, which to-day all lies open before him in that great work, "The Scientific Balloon Journeys of Assmann and Berson." So we have already in the Berlin Society a "new departure" behind us, and again the question arises, what next? when in consequence of numerous scientific successes meterological air journeys have become an institution, and actually a State-supported aëronautical observatory flourishes near Tegel.

But the answer is ready to our question. The Berlin Society of late years occupies itself also with balloon excursions. We can hardly yet describe them as sport, but rather as a recreation for the idler members of our Society, and an introduction to the romance intrinsic to ballooning. Since then there has been an increase in the number of members, and the Berlin Society with its list of about 600 can describe itself as the largest Aëronautical Society in the world.*

I must now ask you to turn your thoughts in succession to Munich, Vienna, Strasburg, and other German and Austrian cities. One good result of our former condition of small States in Germany is, that we have inherited a spirited system of decentralisation. Germany has many heads, and each one has its own ideas, which in their reciprocal stimulation work for the greater good of all. So,

* Amongst our members we count His Royal Highness Henry Prince of the Netherlands, the Duke of Mecklenburg and H.H. Ernest Prince of Saxe-Altenburg.

Digitized by Google

n the year 1889, we find the Munich Society for Aërial Navigation growing from the mother city of Berlin, and to-day it counts 400 members, amongst whom are eight Royal princes.*

This Society, in its earliest organisation sought to combine theory and practice. Its means are not so ample as those of the Berlin Society; but its yearly reports, and also the numerous writings of its members in the "Illustrated Aëronautical News," shows that a very wholesome and helpfully active spirit as practically as scientifically aëronautical prevails within its circle. And indeed the names of Finsterwalder, Ebers and others of its members are known throughout the length of Germany.

In Austria-Hungary, the Vienna Society for Mechanical Flight stands in true brotherhood shoulder to shoulder with the Berlin Society for Aërial Navigation. It is the most aviatic of all the German Aëronautical Societies, and in this particular is a worthy and irreplaceable complement to them. It has about 100 members, and contains with many others, such well-known names as Ritter von Lössl, Kress, Popper, and Wellnev. It was established in 1887.

A very advanced Society, and one that is an important factor in aëronautics, is, that of Strasbourg. Here, under Hergesell, and with great efficiency, has been accomplished the long-time burning wish of meteorologists, namely, the establishment of the International Aëronautical Commission for Scientific Balloon Ascents, which, since 1898, has borne already and constantly such fruitful results to the science of meteorology. It was no easy thing to overcome political opposition and the pettinesses of personal jealousies, but we can say that it has been done in aëronautics, that intelligence has prevailed and barriers have been broken down, now that we are all animated with the same stupendous interest, for the raising of our science and of our culture.

At Strasbourg also, the "Illustrated Aëronautical News" was started, which to-day is the widely read and unique German aëronautical paper, the organ of all the German aëronautical societies. I hope the personality will be forgiven me when I say that I am very proud of having founded this newspaper. In this connection, I want to express my thanks to your President and my friend, Major Baden-Powell, for the kind support he gave me at that moment, and my regret that he tarries so long and so far from us still.

The recent drawing together of the best circles of German life has resulted in an increased interest in aëronautics. Already new societies are springing up in Augsburg and Dresden, and it is only a question of time how soon similar organisations will form themselves in other cities. One can put the number of those who showed themselves interested in the starting of our German Aëronautical Societies at a total of 1,350 members, and I think I can claim that at present in the matter of such a manifested interest in aërial navigation, we hold the record of the world. And we attribute this fact in no small degree to the supreme interest which His Majesty the German Emperor has extended to every aëronautical attempt.

I should like to say a few words over the share taken by our mechanical inventors in the advancement of aëronautics.

As in England and in France, there are with us too numerous experiments to catalogue, which, at the same time, do not call for long notice. I will confine myself therefore to those which not only embody new practical ideas, but which also have been put into some successful practice, and so have valuably contributed to aëronautical advance.

Just now the world rings with the fame of Santos Dumont. Everyone, however, who has followed the technicalities of the development of flight, knows that the young Brazilian has brought to light no new principle, and his success consists in the accomplishing of a feat ordered in advance. But the secret of his success lies entirely in his continued experiments, his improvements, and his again-re-repeated experiments. Santos Dumont made twenty-three experimental flights, Renard and Krebs made seven, Count Zeppelin three. Krebs and Renard had the advantage of being already practised military aëronauts, while other of our aëronautical mechanics and inventors first became aëronauts in their experiments only.

Three names carry with them exceptional experiences: Paul Haenlien, who took out his first patent in England in 1865 (see Brewer and Alexander, p. 32), and built an airship according to his ideas at Vienna in 1872; David Schwarz, who in 1898 put together the first aluminium construction; and Count von Zeppelin, who, through the use of many novelties, attained noteworthy experiences. I should fear to exhaust your patience if I went

* Their Royal Highnesses, Prince Louis of Bavaria, Prince Rupprecht, Prince Leopold, Prince George, Prince Arnulf, Prince Louis Ferdinand, Prince Alfonso, and Prince George Louis of Bavaria.

Digitized by Google

into the details of the work of these three men. I know that amongst you, as all over the world now far and wide, the principles of airship steering and building are well understood, and have been often tried. The rigid connection between balloon hoop and car, the removal of the propellers to nearer the centre of resistance, elongated rigid-kept frameworks, powerful light motors somewhat such as are used in automobilism, gas motors by Haenlien, benzine motors by Schwarz and Zeppelin, firm aluminium bodies, water ballast, and the regulation, in some part, of the vertical motion by the propelling power, also the self-ventilating double envelope essential for remaining long aloft, these, ladies and gentlemen, seem to me to be the salient points which have been seized upon by these three constructors.

The aëronautical industry has made great strides, mainly on account of the military balloons. The leading houses are the Continental Indiarubber Company, in Hanover; the balloon factory of August Riedinger, at Augsburg; and, lastly, the house of Lieutenants Parseval and Sigsfeld, the holders of the patents for the German kite-balloons, no doubt well known to you, for they to-day supply the world of aëronauts, and German kite-balloons, for military and scientific purposes, are used not only in Germany and Austria-Hungary, but also in Italy, Spain, France, Switzerland, Sweden, and North America.

We Germans have endeavoured to contribute our share amongst the nations to the development of a new-dawning and growing science. While in no way disparaging the work of others, may we not say without boasting that we fill our place amongst the nations. We do not feel that we have come to the end of our capabilities of labour. On the contrary, we are convinced that we Germans are called, amongst our other labours, to strive after aërial navigation, and to deliver in aëronautics, as in other matters, a share to the whole human race of many great and precious things to come.

The CHAIRMAN: Of course it is quite impossible for us to give the author a vote of thanks here to-night, so we shall convey your thanks to him through our Secretary by letter. I would like, however, to make some remarks on this paper, after which I should like to hear what others may have to say on the subject. As far as I understand, the Paper has treated the subject of balloons altogether, and I would like to explain some of the troubles which I do not think have been fully gone into in the question of balloons. Navigable balloons are generally made this shape. (Referring to diagram.) They are sometimes called fish-shape, sometimes cigar-shape. Now in order to force this through the air the centre of atmospheric resistance is about here. The balloon is very much larger than the car, and suffers a great deal more of the resistance of the air than the car itself, the car only consisting of a very light framework of bamboo. But the propelling centre is very much below the centre of resistance. Now it is necessary to put this a great deal below the balloon in order to put it on a level. In some French experiments the car has been placed at a very great distance below, but the farther the car is placed below the balloon the greater the centre of effort is below the centre of resistance, so that we find that in pressing the car this way the resistance of the wind pushing it back has a tendency to move the balloon in this direction. (Indicating.) The correct position for the screw would be on the same line as the centre of resistance, but then again we have a difficulty because it would require framework and something to transmit the power, and the framework holding the screw would weigh more than the balloon. And, consequently, we have this trouble, and this is what generally takes place, unless the balloon is inflated and is very full and tight the car is liable to move forward and throw this end of the balloon up into the air. The front end of the balloon becomes enormously inflated with the gas and the back end is empty, so that the balloon assumes this position in the air—the front end going up in the air and the back end falling down as you see. This has repeatedly occurred in France, and it appears it occurred again at Monte Carlo with Mr. Santos Dumont's balloon. The bag of air was not sufficiently inflated, so that when he started his balloon the point went up into the air and the greater part of the gas went into the other end, and the result was it assumed this position—(indicating)—and that is the great trouble which one has with the class of balloons. I should like now to hear what anyone else has to say on the subject.

MR. SPENCER: Sir Hiram Maxim, Ladies and Gentlemen,—I have listened with very great pleasure to the remarks that have already been made on the subject of aëronautics, and first of all I think it must be very useful to us to hear Sir Hiram's remarks on the St. Louis Exhibition. However, as Mr. Bruce suggests, it is well we should be represented there. Passing on to Major Moedebeck's paper, one of the earliest remarks is

Digitized by Google

that skin balloons and figures are now only made in Paris. I think Major Möedebeck certainly goes a step too far there, because it is generally known on reference to any of the price lists of balloon manufacturers that skin figures, as a matter of fact, are daily made in the small village in which we happen to be existing at the present time. As a matter of fact I might say that possibly for many years, even before the British Government took up gold beaters' skin for the purpose of manufacturing balloons we had balloon manufacturers whose business it was to make these toy balloons, and that gave the Government the idea of using skin. Then we come to Dr. Wolfert being mentioned. With regard to the three balloonists who had had a navigable balloon in Germany, to my knowledge this Dr. Wolfert and his colleague were the first two balloonists to take one of our petroleum motors up in a balloon. Dr. Wolfert and his system came to grief, the petroleum motor ignited the petroleum, the balloon was in flames, and the two of them in the first navigable balloon ever constructed in Germany were killed. Passing on to the final remarks Sir Hiram Maxim made with regard to the propelled balloon, there can be no doubt that the points he has raised are important ones, but they are points that are capable with intelligence of being overcome. For instance, as the illustration is drawn there, you see the line of force is more than the diameter of the balloon. Now in the navigable balloon which is at present being constructed in our establishment, the diameter of the balloon is 20 feet, and the car is 10 feet below. One understands that the 10 feet below does not give the line of power so very much below the line of resistance, but one naturally understands that from the very nature of the thing that you must keep the whole of your propelling power well below. That is a point which has to be considered and can be overcome by means of the trail rope to balance the whole lot. People who will not take adequate means to keep their balloon blown out tight must expect it to collapse. At all events, if you are going to propel a balloon rapidly through the air you must keep it tight so that it can force its way as well as a balloon ever can.

The CHAIRMAN: And now, ladies and gentlemen, a paper is to be read by a lady. What more could you ask for? Miss Bacon is the daughter of a very clever man who has for a long time been engaged in the subject of aëronautics and who has made numerous ascents, and I feel quite sure that we shall have to consider that the pièce de résistance here to-night is Miss Bacon's paper, and I shall listen with a great deal of interest to this paper.

Photography from a Balloon.

BY MISS GERTRUDE BACON.

I think what chiefly strikes one with regard to balloon photography is not so much its possibilities, though these are great, as its very strict limitations. The work of a camera aloft is bounded most severely by several natural obstacles which it is quite impossible to surmount, and certain very special conditions, not by any means always to be commanded, are necessary before a really good negative can be secured. The element of chance unhappily enters largely into the matter, so that it is impossible to count with any certainty upon the obtaining of satisfactory results, even when all things seem, to the eye at least, to be entirely favourable.

In pursuing this most fascinating branch of photographic art the first point is naturally the equipment; and here at once we are met by one at least of the limitations mentioned. All exposures made in a balloon must, of necessity, be instantaneous, for a balloon is always one of the most unstable of standpoints, and never for a single moment absolutely at rest. It follows then, in the first place, that none but a "snap-shot" camera, or one that can be adapted for snap-shot work, is any use aloft. Further than this the camera should be especially light and portable, for heavy apparatus is little loved by the aëronaut, who knows the importance of every ounce of extra weight in a balloon, and the effect it has upon the length of the voyage. For the sake of lightness, films, although less reliable and easy to handle, are certainly preferable to plates, in a balloon, more especially taking into account the ever-possible contingency of a rough landing. In view of rough treatment the camera chosen should be a fairly stout one—not liable to be readily broken or injured, and the shutter arrangement should be such that the very probable accident of the introduction of a grain or two of sand from the ballast shall not immediately ruin its instantaneous action.

One more requirement necessary in the ballooning camera is that the films or plates can be rapidly shifted, for once aloft, and the fair and unique views which we long to perpetuate follow each other so fast that it is

Digitized by Google

well-nigh impossible to keep pace with them. More particularly at the commencement of a voyage when the balloon is travelling, not only onwards but upwards, at a very considerable rate, do we want to secure pictures in a hurry; and such views, showing the rapid change of altitude, are generally the most interesting to be obtained in the air.

(Photographs shown.)

When the balloon is travelling rapidly near the ground, say as near as 300 feet, it needs a quicker exposure than there is ordinarily light enough to allow with an ordinary hand-camera, to prevent the photographs taken showing traces of motion. Speaking generally, 250 feet is the inside limit of balloon photography, except under very exceptional circumstances. We, at least, have no photographs taken under that height which are of the least value.

(Photographs shown.)

At 3,000 feet aloft we begin to approach the outer limit of what I may perhaps be allowed to call the "photographic stratum" of our atmosphere. Of course, there are exceptional cases, and exceptional days, when the air is vastly clearer than on ordinary occasions; but taking it as a whole we may safely say that 3,000 to 4,000 feet represents the limit up to which it is possible to secure good results. Nor is this hard to understand. Our atmosphere, as we know it, is full of particles of matter is suspension; be they dust motes or "water dust." Seen from below these particles are invisible to us, and for the same reason that the rest of the moon is invisible when we see her only as a crescent. In other words, the dark, unlit side only is turned towards us. Seen from aloft, however, the case is completely altered. All the particles then have their sun-lit sides pointing upwards, reflecting the light as so many little full moons; and it is the presence of this golden haze which spoils so many pictures by destroying the sharpness and definition so all-essential to a good photograph. Naturally, then, when any great thickness of this dust-laden atmosphere has to be penetrated by the camera lens an indifferent result is to be expected.

(Photographs shown.)

Mr. Percival Spencer has, indeed, secured very fair pictures taken up to a height of 5,000 feet and higher; but these have, if I mistake not, been taken either over or in the vicinity of the sea, when conditions are certainly unusually favourable to balloon photography from the increased presence of water vapour in the air, and in several of his pictures moreover, the distinction between land and water has made sufficient contrast to give some features to a view, taken from a height when all things are generally reduced to a dead level of colour and "texture" (if such a term may be permitted in this connection).

(Photographs shown.)

But there are other conditions, invisible to the eye, not to be detected or even suspected perhaps by the aëronaut, that make or mar the pictures from aloft, as the would-be photographer very soon discovers. On the occasion of the writer's first ascent, to take but one instance, though the day was to all appearance perfectly clear and bright, and though very successful photographs were secured on the ground both immediately before and immediately after the voyage, yet all of the films exposed from aloft were ruined by a haze, very palpable to the camera, though not specially so to the eye. On a later date when my father made an ascent from the grounds of Clifton College on the occasion of the British Association Meeting at Bristol, exceedingly good results were obtained under apparently disadvantageous circumstances; the hour being late, and the time mid-September, while the balloon traversed the usually dust-laden atmosphere lying over the town.

(Photographs shown.)

Many times since the same curious contradiction has been noted, an apparently altogether favourable day yielding indifferent results, and good negatives obtained in much darker and apparently in every way less propitious weather. In all instances where this has been observed, however, it has been shown that favourable photographic conditions have been obtained when the air is heavily charged with moisture; while the drier the atmosphere the less successful the pictures, even though the sun be shining brightly at the time.

(Photographs shown.)

The CHAIRMAN: Ladies and Gentlemen,—I think you will admit that my prophecy has been more than borne out by the fact. In regard to the dimming or paleing effect of the dust in the atmosphere and the difficulty that the photographer has to encounter in this respect, I might say that many years ago the greatest of all lecturers that we had in England, Professor John Tyndall, said: "I feel convinced that I can make just as good a sky as we have." Now then I think I could do it, for it only requires the least particle of dust

Digitized by Google

in the air in order to affect the negative of a photograph. Of course, in damp weather, as has been said here to-night, this dust is less abundant. Water produces no effect at all unless the air is below the dew point. If the water shows it is in little globules in the air, then, of course, it has a similar effect to dust; but the presence of water in the atmosphere does not affect the photograph at all, as I understand it, unless the atmosphere is cold, so that the water is visible to the eye in the form of fog. I think we may therefore conclude that it is the dust, that is bits of silica, lime, and organic matter in the air that forms the dust, which is so detrimental to photography. I now move a hearty vote of thanks to Miss Bacon for the very excellent paper which she has read here to-night.

(Carried by acclamation.)

Further Notes on the Barton Air-ship.

By Dr. F. A. Barton.

Mr. Chairman, Ladies, and Gentlemen.—Nearly three years ago I had the honour of reading before this Society a paper, in which I gave a short history of my various experiments in aërial navigation, the results I had obtained, and the conclusions I had arrived at; and as there are probably many here to-night who were not present on the former occasion, perhaps it would be as well if I briefly referred to those experiments again.

My first series of experiments were made in 1883, with a cigar-shaped balloon, below which was an elongated car, carrying a propeller at the stern and a rudder arranged on a light framework between the propeller and end of the balloon. The propeller was worked by twisted india-rubber bands.

The machine was only a big toy, but I was able to draw the following conclusions:—

1st. That it was quite possible to propel and steer an elongated balloon through the air, horizontally, provided a sufficiently light and powerful motor could be found.

2ndly. That there was no method of causing the balloon to rise and fall except by throwing out ballast or letting out gas, or by tilting the balloon by means of a sliding weight.

3rdly. That if the balloon were not properly filled and tilted ever so little, the gas would all rush up to one end, and that there was no method of bringing the balloon horizontal again.

4thly. That there was great danger of the propeller getting entangled in the rudder lines and, indeed, of ripping the balloon itself.

5thly. That the shape of the balloon is of great importance, as the after suction is a most important factor.

In my second series of experiments, I discarded the balloon altogether and made a machine consisting entirely of aëroplanes, some of which were fixed, others moveable. The whole of the aëroplanes were attached to a light framework of wire, which, in its turn, was rigidly attached to the car, which carried the propeller.

My experiments with this machine were somewhat of a limited nature, as the repeated falls which it had very soon twisted up the framework and broke the aëroplanes; however, I arrived at the following conclusions:—

1st. That the aërodrome or machine composed entirely of aëroplanes was the ideal machine for rapid transit through the air.

2nd. That the lifting-power of aëroplanes had been considerably underestimated.

3rd. That the great want of stability was the chief difficulty in the use of aërodromes.

4th. That even if this difficulty could be overcome by means of a carefully conceived system of aëroplanes, there would still be a great element of danger in working the machine, supposing that anything should go wrong with the motive-power.

On another occasion I carefully went into the subject of birdlike structures, having been told that we should never succeed unless we copied nature, but I never made any experiments with models as I was convinced that we could never put into any machinery that nervous system which enables a bird automatically by reflex action to adjust its feathers to the varying currents of the air.

For some years after the experiments which I have just mentioned, I did nothing further, although from time to time I used to turn the matter over in my mind, and it was not till the year 1898 when it occurred to me one day to make a machine combining the two principles, namely, an aërodrome with a superimposed cigar-shaped balloon.

The first machine which I made on this principle had a balloon 21 feet long, 5 feet diameter, made of gutta-percha tissue, below this was the aëroplane frame, composed of light wooden rods braced together by fine wire: this framework had a horizontal moveable aëroplane in front and a vertical aëroplane or rudder at the back.

Rigidly suspended from this aëroplane frame

was the elongated car which carried the propeller of four eight-inch blades, worked by a powerful clock which ran down in about 15 minutes.

I believe I was the first to hit upon this idea of interposing moveable aëroplanes on a suitably-constructed frame between the balloon and the car, and after an exhaustive search by myself and others at the patent office and in aëronautical literature I can find no anticipation of it.

I tried at first in the Public Hall at Beckenham on the 10th of March, 1899. It ascended with the greatest ease from the platform at one end, and was driven to the balcony at the other end, from which the plane having been reversed by hand, it was driven back, descending steadily to its original starting point. The plane was then placed horizontally and the vertical aëroplane or steering rudder put hard a-starboard, when the machine went round the hall, which was only 33 feet wide, five times in succession, keeping the same level throughout. The rudder being then reversed it went about four times round in the opposite direction, when the power of the clockwork was exhausted.

This experiment showed me that I had solved the question of aërial navigation, as the aëroplanes and steering apparatus answered in every respect the purposes for which they were intended.

A few days later I tried the machine out of doors, when there was a strong gusty east wind blowing. The balloon immediately rose about 50 feet in the air, and went away down wind about 300 yards, the limit of the line attached. Various experiments were then made, and though the power of the fan was nothing like sufficient to drive the balloon against the strong wind blowing, one important point was proved, that the action of the fan and aëroplanes kept the balloon perfectly steady and horizontal even in the strongest gusts. Before the balloon was started, in spite of its being held by two or three people, it pitched violently up and down and rolled from side to side. Directly it was started it kept perfectly steady, and it remained always quite level.

Fourth Airship.—Having found that the principle was correct, I made a larger balloon about 35 feet in length, adding various improvements that suggested themselves.

This machine was tried first on the 12th of May, 1899. There was a gentle breeze blowing, but too strong for the clockwork, which only weighed 4 lbs. in all, to drive the balloon against it. The clockwork was the same as had been used for the smaller balloon, but with a new fan, which gave better results.

I first experimented with it as a captive balloon, trying its lifting power, etc. I then wound the clockwork up to the fullest extent, set the horizontal aëroplane so as to cause the balloon to ascend and the vertical aëroplane to starboard so as to steer the balloon across the wind. Having opened a small hole in the top of the balloon I started the clockwork and cut the balloon adrift. Although there was but little lifting power in the balloon, the action of the aëroplanes caused it to ascend as it gathered way, and in ten minutes it had reached an altitude estimated by onlookers at 800 or 1,000 feet. I found not only that the balloon kept quite level but that it steered perfectly, sailing straight away across the wind. As the clockwork gradually became exhausted the balloon took a course nearer the direction of the wind, until in about 15 minutes the propellers ceased to revolve, when a most noticeable change took place and the balloon began at once to turn round and round on its axis like an ordinary balloon and drifted away with the breeze, finally descending at Bickley Park a distance of about 3½ miles after a flight of about 23 minutes.

I carried out altogether some three or four series of experiments with this balloon to satisfy myself on various points that were necessary for the successful working of one of full size, and considerably improved my original arrangements, modifying them so as to meet the difficulties that arose from time to time and working out the practical details.

Few people have any idea of the many questions that have to be settled in order to produce a successful airship, and it is only by continuous application and retaining the very best experts on the different kinds of work required, that this result has been achieved. I would like to-night to publicly acknowledge the invaluable help that I have received from those who have assisted me.

Amongst the experts I have retained are Mr. F. L. Rawson, the well-known consulting engineer for inventions, who has assisted me in working out the weights and strains and general details of the machine; Mr. W. G. Walker, one of the greatest authorities in the world on air propulsion, who has made a special study of air propellers and fans and the resistance of surfaces in the air, and has also carried out various series of experiments for the Institution of Mechanical Engineers, the British Association, and the Royal Society.

Digitized by Google

Mr. Walker has worked out the wind resistance of the machine and thrust which may be expected from the propellers when driven by the engines I propose to employ. Mr. Walker has allowed a liberal margin in his calculations, but says that there will be no difficulty in obtaining the speed required by the War Office, as the thrust from the six propellers will be nearly double that required to counteract the resistance of the machine when travelling at the required rate.

Mons. A. E. Gaudron, the well-known balloonist, who is the only man in England who has successfully experimented in the air with a motor-driven airship, has also been retained by me as my consulting aëronaut.

I have pleasure in showing you this evening a model of the airship, which is of the scale of 1-12th, that is, an inch to a foot.

You will notice that the aërostat is more or less cigar-shaped, the largest diameter being considerably forward of the centre.

The balloon will be made of the best Japanese silk and be divided into four compartments, one division being between the nose and the main body, another between the main body and the tail, and the main body divided by a third.

The divisions will not be tightly stretched diaphragms, but quite loose, so that when the gas in the nose and tail expands, the diaphragms will bulge into the main body.

Under ordinary circumstances the fore and aft compartments will be closed although there will be a special arrangement under the control of the aëronaut by which the gas can be allowed to escape, should the tension become too great after the diaphragms are fully expanded.

Inside the main balloon will be a balloonet or smaller balloon filled with air.

When the airship first rises from the ground the hydrogen gas with which the four compartments of the balloon are inflated expands, and the air is allowed to escape out of the balloonet by the aëronaut, who has control of the valves and neck of the balloon.

Over the balloon is a second covering of Japanese silk, which is called the chemise, the edge of it is indicated by the line running round the balloon longitudinally.

In the full-sized machine this edge will contain fine stripes of bamboo bound together, so as to make one continuous bar, to which may be attached the cords which suspend the aëroplane frame.

Similar rods composed of split bamboo and bound round with fine cord are carried up to the nose of the balloon, and for a certain distance on to the top, whilst others again are carried from the nose along the side for an equal distance as the top bar.

The ends of these rods will be connected by circular pieces of bamboo, and there will also be a connecting circle half-way between this and the nose. These bamboos will be sewn in gussets in the chemise, and will greatly help to maintain the proper shape of the balloon when being propelled forwards.

Now the advantage of this chemise and arrangement of bamboos are many.

1st. It gives greater strength and rigidity to the balloon.

2nd. No cord, metal or roughness of any kind comes in contact with the balloon.

3rd. Under ordinary circumstances it will greatly prevent leakage of gas from the balloon as it is extremely unlikely that there would be two holes, one in the balloon and one in the chemise exactly opposite one another.

4th. In warfare, supposing the balloon and chemise were both penetrated by bullets or a shell, a certain amount of gas would undoubtedly escape, but as the balloon got smaller the two envelopes would slide over one another, until, in a few minutes, a portion of the chemise would cover over the hole in the balloon, and it would thus be self-sealing.

The arrangement used by Mons. Santos Dumont of having his car suspended by wire cords directly from the balloon, is, I consider, likely to be an element of great danger, as at any time one of these wires might snap and tear the balloon.

In his case, however, weight is the first desideratum, and everyone, I know, must have admired his energy, resource and pluck under some of the most trying conditions.

My object throughout my experiments has been to produce a machine which may be relied on, to navigate the air in all ordinary weather and at the same time to secure for the aëronauts and passengers the highest degree of safety.

Suspended below the balloon you will see the aëroplane frame, which, in the full-sized ship, will be made of tubular steel. This, when properly braced by steel wire in tension, makes an exceedingly light, rigid and reliable framework on which to support the aëroplanes, rudder, and car.

The aëroplanes you will observe are arranged in an entirely novel manner, and are also made to work in a new way to any tried previously.

The position they now stand is that which would be used when the machine is intended

Digitized by Google

to maintain an exactly horizontal position in the air, other things being equal. You will notice that the planes are perfectly flat and offer no resistance in the air on either their upper or under surfaces.

We will now suppose that it is required to bring the airship down to a lower level or to keep it on the same level when the lifting power of the balloon is greater than required, as, for instance, when the sun comes out from behind a cloud. To accomplish this the posterior end of the aëroplanes is raised by means of a wheel on deck, and you will now notice that instead of being aëroplanes they are aërocurves with a resistance on their upper surface which either causes the machine to descend or to keep the same level by increasing the weight to be lifted by the balloon as the case may be.

When it is required to take the airship higher or to keep it at the same level when the gas contracts, as, for instance, at nightfall, or even in the daytime, when the sun goes behind a cloud, the opposite proceeding to that which I have first shown you is done, namely: the back part of the aëroplane is lowered, and this forms an aërocurve which gives a still larger resistance on its under-surface. I say a "still larger resistance" because you will notice that the end can be lowered three inches but only raised two and a half, that is to say, it has a rise of one in five and a fall of one in four. The posterior vertical aëroplane is worked like any ordinary ship's rudder, by a wheel on deck. The top of the aëroplane frame is covered with a fine cotton net to prevent the balloon coming in contact with steel of the aëroplane frame.

From the top of the frame over the forward and stern propellers are arranged tubular steels like davits with a similar network stretched from one to the other. This is to prevent the balloon being blown on to the propellers in the event of a sudden squall catching it sideways. I am sorry I had not time to put this network and davits on to the model. The car, which is of an elongated form is suspended from the aëroplane frame by steel wires at intervals of two feet and tubular steel at intervals of 12 feet.

The car itself is made in the form of a light girder, and although shown in the model as brass, in the full-sized airship will probably be made of nickel steel or some other chemically or electrically treated steel. The deck of the ship is made of fine wire netting covered with Indian matting or some such light material; the length of the deck is 104 feet, and, with the exception of the platforms for the motors and steering-wheels, is only two and a half feet wide on its surface. The sides are protected by larger netting, along the top of which is a tubular steel connected with the tubular steel suspension rods.

This rod serves the double purpose of keeping the netting tight and of acting as a support for the petrol tanks which are ranged along it.

Each tank holds seven gallons of petrol and there are 36 of them in all.

The tanks are arranged in this form as a convenient method of storing. Over each motor is a light framework to which a petrol tank is suspended. The supply pipe to the carburettor can be attached directly to the tanks and is divided at the upper end, so that when one tank is nearly empty another can be placed in position and attached to the free end of the pipe before the first tank is removed.

It is proposed to take up only a very small supply of ordinary ballast in the shape of sand, but to utilize the petrol in case of emergency; also the water in the tanks which I now draw your attention to; the tanks are two in number and situated at the extremities of the deck. Each tank is capable of holding 40 gallons of water, and when the ship is ready to leave the ground and is properly trimmed each tank should be half filled with water.

These tanks are connected by pipes running under the deck to a two-way pump which is worked by a small independent motor.

By means of this pump the water is kept circulating between the two tanks continuously. Just in front of the helmsman is a pendulum which is capable of swinging fore and aft, whenever the airship moves out of a horizontal position. By a simple arrangement of levers, the swing of the pendulum either shuts off the water from passing along one pipe and opens wide the cock in the other, or vicê versâ, according to whether the ship is down in the bows or stern.

In the ordinary way when the ship is level both cocks are half open.

For the sake of explaining this I will give you the following illustration:

Supposing something goes wrong with the forward motor which requires the assistance of one of the other engineers to set right.

It follows that as the man from the middle or other end of the car walks along the deck the centre of gravity of the machine is altered and the ship would pitch down in the bows.

Digitized by Google

Now the pendulum arrangement comes into play, for directly the ship begins to sink in the bows the water is shut off from flowing from the rear tank to the one in the bows, whilst more water than usual is pumped from the bows to the stern, and this is automatically carried on until the pendulum is at right angles to the deck when the cocks are both half open again.

The contrary takes place when the bowman has to go to the stern.

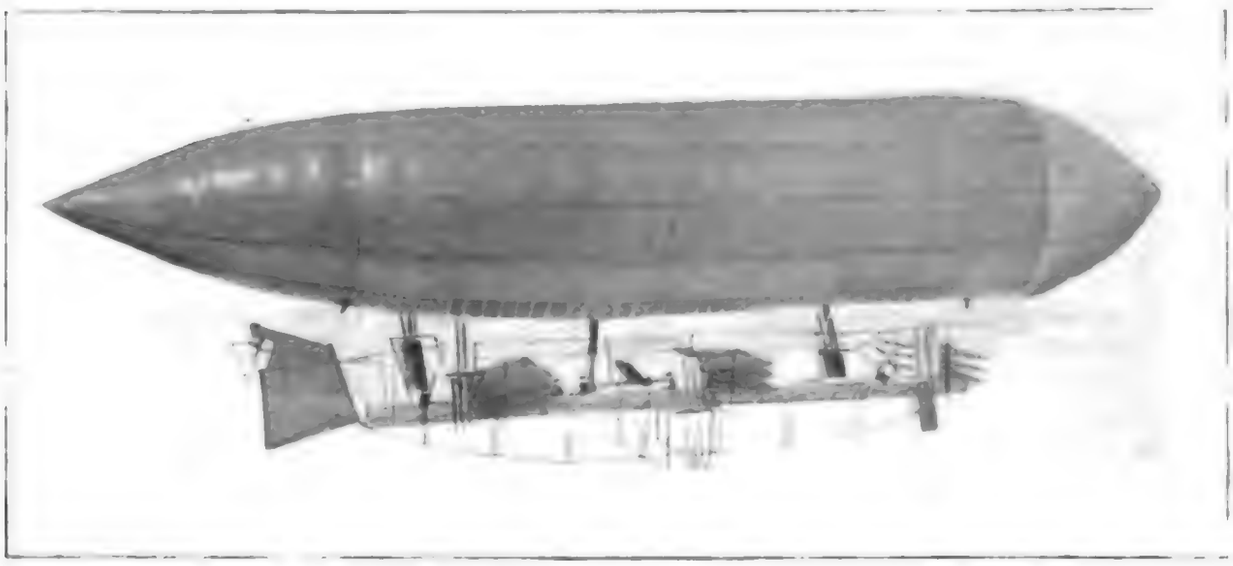
Although this apparatus works automatically as a general rule there is another simple arrangement under the control of the helmsman or aëronaut, who are both on the same platform, by which the pendulum can be fixed in any position, so as to cause the whole of the water to be pumped into one tank or the other.

This would only be required to be done supposing it were necessary to help the ascent or descent of the balloon by tilting it upwards or downwards in the manner employed by Count Zeppelin and Mons. Santos Dumont with their sliding weight and trail-rope. It could also be utilized in the event of the gas going up to one end of the machine, although this is scarcely likely to happen in the case of a balloon divided into compartments and fitted with a balloonet.

The tanks are, both fitted with large emergency cocks by which they can be emptied in a very few seconds, thus relieving the machine of about 400 lbs. weight of water.

There is some other arrangement for regulating the vertical action of the airship which is not shown in the model. At the present time this method is known only to my consulting engineer and your Honorary Secretary who has taken a very great deal of interest in my machine and has kindly written a report on it from an aëronautical point of view.

I am sorry I cannot tell you about this vertical steering arrangement, as it is, to my mind, by far the most important factor in my invention, and at the same time is remarkably simple. However, I have not taken out any protection for the invention, nor do I intend to do so at present. I am ready, however, to put this improvement together with several other important additions into my full-sized machine, provided the War Office make it worth my while.



The Barton Air-ship.

The only parts now remaining to be noticed are the propellers, which are six in number, arranged on different levels in pairs on each side of the car.

Each propeller consists, as you see, of six blades arranged in three pairs behind one another, on the "Mangin," or box girder type. They are, according to Mr. Walker, extremely light, rigid and powerful, and give far more thrust per h.p. and less slip than any other form of propeller.

They are 17 feet from tip to tip, and each blade is two and a half feet across.

They will travel at 250 revolutions per minute, each pair of propellers being driven by a 40-h.p. motor with four cylinders.

There are several other points I should much like to bring before your notice but the time is so short that I will not trespass on your

Digitized by Google

patience any longer. From what I have said I think you will see that in this machine which I am showing you this evening, I have been able, by combining the navigable balloon and aërodrome, to overcome all the difficulties which are experienced when using them separately. I think this machine will prove efficient, and above all safe, and will give us a grand opportunity of being able to experiment with aëroplanes without the danger which has hitherto attended their use; and that ultimately we may be able to reduce the size of the balloon very considerably.

I am extremely obliged to you for the attention you have given to this paper, and I hope before many months are over to be able to show you the full-sized machine in actual flight.

The CHAIRMAN: Ladies and Gentlemen,—I am sure you have all been very much interested in the paper which has been read to us. Still, I may say, I am of opinion there is too much machinery to catch the air beneath the balloon. In my experiments I found that it requires an immense amount of energy to drive a series of tubes and pipes through the air, much more than I had any reason to believe. Very curiously I found that two round bodies placed near together require more power to drive them sideways through the air than they did singly. The lecturer has spoken of the effect of aëroplanes; he says they are more than he expected. That is true in some respects, but not in other respects. I will give an illustration. This is an imaginary line, and we have a line down there which we call the sine of the angle. Now suppose, for instance, that this sine of the angle is two feet, and we will suppose that the distance from here is 10 feet, it will then be seen that when that plane travels 10 feet it will push the oar down two feet, and it was computed that the lifting effect would be just the same as it would be if air were blowing against the plane at a speed which would blow the plane downwards; it was said that the lifting effect, this being equal, was in proportion to the square of the sine of the angle. However, Lord Raleigh made some experiments, I made them myself too, but Lord Raleigh is a better authority than I am. Suppose the sine of the angle in this case is only one, consequently this ought to lift four times as much as that; but it does not. If we put two of these together on one end of a long arm and rotate it, that one ought to lift more than the two, but it does not; two of these lift more than one of these, so it shows when we have slight angles that the lifting effect does not increase in proportion to the square of the sine of the angle. Aëroplanes in which the sine of the angle is very small, lift a good deal more than they ought to according to the theory; but when the angle is very sharp they lift the same. The old theory has been in use in computing the power of sails for many years.

MR. SPENCER: Mr. Chairman, Ladies and Gentlemen,—I have looked with the very greatest interest on this proposed navigable balloon of Dr. Barton's, perhaps, I might say, because I am practically interested in ballooning and shall be propelled through the air, possibly over London, within a very short period. We have a balloon in course of construction, and, perhaps, that fact might be considered as putting me in a good position to criticise another machine, even though it is in the model form. I trust, however, that the remarks I may make which are made on the results of a full-sized balloon, may be of some use. Looking at the model of this balloon, the first thing that strikes me about it is that when it is made full size and filled with hydrogen gas it will not lift. I can see that a framework in that proportion, made with steel bars and with those heavy propellers and three 45-h.p. motor engines will probably be theoretically all that is intended, but when the thing comes to work I am afraid the weight will work out so great that the balloon will not ascend. That is the first broad principle that occurs to me. The diaphragms in the middle of the balloon are, undoubtedly, a useful step, but there is no doubt about it that these diaphragms will sooner or later if they are not protected with any means of escape, will burst if the balloon ascends to a very great height, because whether you have a balloon large or small, provided it is on an upward course, that balloon will ascend and ascend until the balloon, however large, is full; and then comes the time when you are in exactly the same position as you would be were your diaphragms small and with an open mouth—the gas will either slowly escape or it must explode the material that is confining it. The final idea that appears to be unique in Dr. Barton's invention is the system of balancing it by means of water ballast at each end. Now theoretically that sounds very nice for taking our propelled balloon through the air, but practically I am afraid that whenever that is tried on there will be the difficulty of the pumping work, and at the best I am afraid

Digitized by Google

we shall only keep up a see-saw motion that will be more troublesome and more dangerous than the simple scheme which our distinguished foreign visitor is adopting, viz: that he keeps a trail rope by which he can pull the weight entirely and easily over to one end or the other of the balloon. By that means you can keep the balloon on an even keel, providing it is full. That seems to me to be after all even simpler than the system of pumping water. Summing up the few remarks I have made, I am very much afraid that I must think in my own mind that everything that is really new in that balloon is not good, and everything that is really good in it is not new.

Mr. Reid: I should like to make one or two remarks. I have known this balloon, or rather not exactly this balloon, but Dr. Barton's balloon for some years. We have seen models here before, and there is one thing about it which I must say I especially admire, and that is the way in which Dr. Barton has accepted modifications and taken the best of the suggestions that have been offered to him by those who are expert in the different matters which come into the construction of a balloon. Now it is very likely, as Mr. Spencer has said, that if this model were carried out exactly 13 times, or whatever it may be, the size it is at present, it might not be exactly what is expected. We all know that a model does not exactly represent the thing itself on a large scale, but I have no doubt whatever that as Dr. Barton has made his experiments in a practical way, and has actually made balloons which have gone up and gone round and descended into people's gardens and gone almost on the same lines as Santos Dumont himself, that eventually when he comes to carry this out on a large scale it will be successful. There is one point I should like to criticise, and it is this, that I do not think the nose of the balloon is sufficiently rigid. I may not, perhaps, have understood the construction thoroughly. I believe it is split bamboo in gussets or something of that kind, but I should like to see the nose of the balloon made almost as rigid as it could be made, because if that does not take place, and you navigate a balloon of this kind against any considerable velocity of wind, the pressure of the wind against which you are going will probably cause a deformation of the nose of the balloon, and such a deformation would be greater than the planes which are to guide the balloon, consequently the balloon will not be guided by the planes, but rather by the front of the balloon. I think, with that slight modification, there is no reason whatever why the balloon should not work. As to the weight of the motors that are to be put into it, I must say that Dr. Barton, when he talked about three 45-h.p. motors, rather staggered me; but we have made such great advances in the power of motors, to which you yourself, sir, have contributed very much, that it is quite possible that such power might be got at moderate weight. But even if it is not so, it is not absolutely necessary to have such a power. I think myself that one 45-h.p. engine would be almost sufficient to propel the balloon against any wind that the structure of the balloon itself will stand. I think Dr. Barton is very much to be congratulated on the skill and thought which he has bestowed upon this problem. We see on the other side of the Atlantic, where you hail from, and on this side we see thought being continually devoted to this very important problem. One characteristic is very necessary in carrying out researches of this kind, and that is patience. Another is courage, and we certainly find that other nations are not behind us in the courage, but I do think the Anglo-Saxon race possesses the property of perserverance in the very highest degree. And we look forward to this problem of aërial flight, whether by balloon or not, I have a kind of conviction that it will be a member of the Anglo-Saxon race who solves it eventually.

Mr. Rawson: When Dr. Barton first came to me and my advice was taken as to whether this balloon would be practicable and would be able to fulfil the conditions of the War Office I was certain that subject to the calculations working out in the way expected that it would be a practical thing. The principal difficulty with flying machines is the question of rising off the ground and the question of getting on to the ground when you have done your work. With regard to what Mr. Spencer said, when Dr. Barton first came to me his intention was to lift about 6,000 lbs. I made a great many additions and alterations increasing the weight to be lifted up to 9,400 lbs., that includes a thousand pounds dead weight for ballast, and that can be utilised in case of difficulties. In the event of extra weight being carried, or in the event of the balloon being required to rise very rapidly that weight is to spare. I think Dr. Barton has not mentioned his various improvements which he has given to me, but the question of rising from the ground and descending safely I think has been entirely overcome, that being

Digitized by Google

the principal difficulty. I might just say that the real value of the invention is that for the first time we get a practical method of experimenting upon aëroplanes. The principle is this, that the balloon will go up about 2,000 feet and then you will rise to 5,000 or 6,000 feet, and in the event of an accident happening, you will only come down to the original 2,000 feet, and so one will be able to make experiments to one's heart's content. I am perfectly certain myself, that a satisfactory flying machine will be evolved. Sir Hiram Maxim has taught us what we should do, and I am perfectly certain the flying machine of the future will be somewhat on the aëroplane line.

Mr. Longworthy: I should be very much pleased if Dr. Barton could give us some little details with regard to these 45 h.p. motors. Lately, I remember seeing a note of some new petroleum motor which had been invented in France, and was safe to give 1 h.p. for each 2 lbs. in weight. That appears to be a very great advance on anything that has hitherto been done, and it would be very interesting to know what the weight of these 45-h.p. motors which Dr. Barton proposes to use is. If we take it as 2 lbs. per h.p. that represents a weight of 90 lbs. for the two motors. It seems to me very much below the weight of the motors used by Santos Dumont, and therefore it would be extremely interesting to have any information which Dr. Barton could give us in regard to the construction of these motors.

Mr. Gaudron: When Dr. Barton came to see me I saw his idea was practical and could be carried out on a vast scale, and so I had no hesitation in joining him to work it out. We decided the tapestry should be 160,000 cubic feet made in four compartments, and as the motors and car will weigh, with a thousand pounds of ballast, 9,400 lbs., I have no doubt we shall see his balloon rise the same as we have seen others which have been built over the past 24 years of my ballooning experience.

Mr. McNair: Mr. Spencer has cast a doubt on the lifting capacity of this balloon on a large scale. I can put the lifting power of this large balloon into figures. If the large balloon is inflated with hydrogen gas the capacity will be 160,000 cubic feet. That capacity at 70 lbs. per thousand cubic feet of hydrogen will give a lifting power of 11,200 lbs. Dr. Barton has told you that the weight of his car is 9,400 lbs., and I may tell you that the 9,400 lbs. includes the weight of the balloon and a thousand lbs. of ballast, so that you will see that it has a good surplus of lifting power and could take additional ballast if necessary. All the calculations for this balloon have been carefully worked out, and I do not think anybody, much less Dr. Barton, who has given so much attention to the matter would continue experiments under the advice of experts if he were not pretty certain of his results, and I think the greatest praise is due to him for the perseverance and tenacity with which he has gone on.

Dr. Barton: I think there is only Mr. Percival Spencer to reply to. When I was speaking about the diaphragms, I said at the same time that there were safety valves connected which were under the control of the aëronaut by which gas could be allowed to escape from the fore and aft compartments, if the tension became too great. The trail rope I think is a most dangerous thing. Santos Dumont has come to grief several times with it; it is always getting caught up and I think it is very dangerous. This arrangement of the water ballast is very simple; it can be easily worked, and if it does not go right at any time you can simply let out the water and you are free from anything. There is nothing to catch in trees or telegraph wires or anything else. With regard to the weight of the motors, there are three 45-h.p. motors, and the three motors with everything complete will come to just under 1,000 lbs.—330 lbs. each. Santos Dumont is going to use them himself. I have seen about that motor you mentioned, I should very much like to get hold of it.

The Chairman: Mr. Longworthy has asked several questions to-night. He said he has heard of a motor that only weighs 2 lbs. per h.p., I do not know who the authority is; I think it is Mr. Pennington. Some years ago he made an extremely large balloon for the purpose of taking fruit from Chicago to New York, and he was also going to bring coal and bricks down to New York City. There was only one trouble about it and that was it wouldn't work. Now I have to criticise Mr. Spencer. He thinks it won't have lifting power enough; the thing is out of proportion; it doesn't appear that the balloon is big enough to lift all that machinery. Well, again we shall have to appeal to that great authority, Mr. Pennington, of Chicago. Mr. Pennington made a balloon—or at least a pattern of one—in which he had many accommodations, smoking room, marble staircase, ladies' room, library, piano, and so forth. You may ask how he got the lifting effect. It is the easiest

thing in the world, all the machinery and furniture were made hollow. Then it was found it wouldn't hold up, but he got over that by pumping more hydrogen in, and hydrogen as you know, has a distinctly lifting effect. So all these troubles were solved by Mr. Pennington. (Laughter).

I wish to call your attention to some prints that we have here to-night by the Hon. C. Rolls, who has a very fine historical collection of everything relating to aëronautics, and we have also a fine collection of photographs from Miss Pilcher. She is an hon. member of our Society, and she has given us everything that is left from the effects of her brother, relating to aëronautical subjects. Some of them are most interesting, and we feel very thankful to Miss Pilcher for them. May I offer a vote of thanks to Dr. Barton for his paper relating to this machine.

Major Trollope: Ladies and Gentlemen,—It affords me great pleasure to be asked to propose a vote of thanks to our Chairman who has kept us amused in many ways. I am perfectly certain you will agree with me that we could not have had a better Chairman.

Carried with acclamation.

The proceedings then terminated.

Applications for Patents.

(*Made in January, February, and March.*)

Compiled by Bromhead & Co., 33, Cannon Street, London, E.C.

25,760. December 17. Howard Lane. **Improvements in or Connected with Navigable Balloons.**

25,867. December 18. Carl Ritter von Blumencron. **Improvements in and Relating to Balloons and the like.**

26,125. December 21. Alexander Winter and Joseph Levi. **Improvements in or Relating to Means and Appliances for Directing the Navigation of the Air.**

26,390. December 23. John Lenn. **Improvements in or Connected with Navigable Balloons or Flying Machines.**

245. January 8. Henry Charles Oscar Mawrood. **Improvements in Navigable Aerostats.**

623. January 9. William G. Hicks. **Flying Apparatus for Toys and other purposes.**

693. January 9. William Arthur Percy Werner. **Improvements Relating to Aerial Ascension and Propulsion.**

1,281. January 16. William Miller Walters. **Improvements in Appliances for Raising and Moving Bodies in the Air.**

2,812. February 4. Anton Neumayer. **Improvements in Navigable Air-Ships.**

2,845. February 4. Alfred Julius Boult (for Cesari Feroci, Italy). **Improvements in or Relating to Aerostats.**

2,923. February 5. Edmond David. **Improvements in the Employment of the Movement of the Recoil of Arms for Propelling Balloons or other Aerostatic Vessels.**

5,020. February 2. Andrie Delport. **The Flapping or Paddling Flying Machines.**

5,261. March 3. Eardley Delauney Billing. **Reversing Gear for Motor Launches, Airships, &c.**

6,300. March 14. Alfred Hardie. **Improvements in Connection with Aeronautical Machines.**

NOTICE.

Owing to the unusual length of the last General Meeting of the Aëronautical Society, and consequent pressure upon our space, the Notes, Foreign Aëronautical Periodicals, and Notable Articles, are held over to the next issue of the Journal.

Digitized by Google

20.5
245

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH.
AUG 4 1902

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain.

By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 23. JULY, 1902. VOL. VI.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AËRONAUTICAL SOCIETY	39
AËRONAUTICS AND PEACE	40
THE FATAL ACCIDENT TO "LE PAIX." *(Illustrated)*	40-41
RECENT LECTURES ON AËRONAUTICAL SUBJECTS AT THE SOCIETY OF ARTS—	
1. SCIENTIFIC OBSERVATIONS AT HIGH ALTITUDES. By the Rev. J. M. BACON	40
2. "THE USE OF BALLOONS IN WAR." By Mr. ERIC STUART BRUCE, M.A.	43
THE MELLIN AIRSHIP. *(Illustrated).*	44 & 45
THE BERLIN CONGRESS OF THE INTERNATIONAL AËRONAUTICAL COMMISSION—	
1. ASCENTS TO EXTREME HEIGHTS—	
(1). "PROFESSOR CAILLETET'S NEW APPARATUS FOR INHALING OXYGEN"	46
(2). "THE RECENT HIGH BALLOON ASCENT OF DR. SÜRING AND DR. BERSON"	46
(3). "THE PHYSIOLOGY OF ASCENTS"	47
(4). ORNITHOLOGICAL OBSERVATIONS FROM BALLOONS	47
2. THE MEASUREMENT OF ELECTRICITY IN THE AIR	47
3. THE BALLON-SONDES EXPERIMENTS	48
4. THE HARGRAVE FLYING MACHINE	48
NOTES.—NEW AËRONAUTICAL INSTRUMENTS—THE VARIATION OF TEMPERATURE WITH HEIGHT — THE APPLICATION OF BALLOONS AND KITES TO WIRELESS TELEGRAPHY—THE ST. LOUIS AIRSHIP COMPETITION — THE SHEFFIELD FATAL PARACHUTE ACCIDENT — THE COLLAPSE OF THE No. VI. SANTOS DUMONT BALLOON	49-51
FOREIGN AËRONAUTICAL PERIODICALS	51-52
NOTABLE ARTICLES	52
APPLICATIONS FOR PATENTS	53

LONDON:

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

Digitized by Google

THE AERONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Gough Square and Bolt Court, Fleet Street, London, E.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL :—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901.

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

Digitized by Google

THE AËRONAUTICAL JOURNAL.

JULY, 1902.

The Aëronautical Journal.

(PUBLISHED QUARTERLY.

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

19, Campden House Road,
Kensington, London, W.

NOTICES OF The Aëronautical Society.

GENERAL MEETING.

The concluding General Meeting of the Session of the Aëronautical Society of Great Britain will take place on Thursday, July 17th, at the Society of Arts, John Street, Adelphi, at 8 p.m., Major H. C. ROBERTS in the chair.

On this occasion the Brazilian Minister, accompanied by the staff of the Brazilian Legation, will honour the Society by his presence.

The following Papers will be read:—

"The 'Peace' Balloon of the late Senhor Augusto Severo."

1. By Dr. Carlos Sampaio.
2. By Mr. Eric Stuart Bruce, M.A. (with lantern illustrations and experiments).

A vote of condolence with the Brazilian Nation on the lamented death of the late Senhor Augusto Severo will be proposed from the Chair.

The Brazilian Minister will reply.

"Balloon Ascents in Thunderstorms," by the Rev. J. M. Bacon (with lantern illustrations).

Note on "A Performance of the Bristol War Balloon during the South African War," by Captain H. B. Jones, R.E.

Note on "The Cycala Flying Machine," by Dr. Charles Zimmerman.

INTERNATIONAL KITE COMPETITION.

There will be an International Competition for the Highest Kite Flight under the auspices of the Aëronautical Society of Great Britain, in 1903. Further particulars will be shortly announced.

ERIC STUART BRUCE,
Honorary Secretary.

Digitized by Google

Aëronautics and Peace.

The announcement of the establishment of Peace has been received with exultation by every scientific society in Great Britain, but it may with reason be said that in the reception of the welcome news aëronauts had a joy peculiarly their own in the knowledge that the balloon has played so prominent a part in the attainment of conquest and peace. The successful operations of the military balloonists in South Africa have from time to time been chronicled in the pages of this Journal. The graphic account of the exploits of the aëronauts in critical situations given by Colonel Templer last July, in reply to a question asked at a meeting of the Aëronautical Society, made the members fully aware of the competency to which our national balloon equipment has attained. The services of the balloonists were further noted in a lecture given before the Society of Arts last February by the Honorary Secretary of the Aëronautical Society. Still further confirmation of the usefulness of the balloon in the South African war will be forthcoming at the next meeting of the Aëronautical Society in a note by Captain H. B. Jones.

The news of Peace has brought to the members of the Aëronautical Society the pleasant expectation of the return of the President of the Society, who throughout the whole of the campaign has been unceasingly at work, and has of late been occupying the post of President of the Compensation Board.

Just as we are going to press the news has come to hand that Major B. T. S. Baden-Powell left Cape Town for England on board the *Tagus* on June 30.

The Fatal Accident to "Le Paix."

The tragic fate of Senhor Augusto Severo and M. Georges Saché and the total destruction of the navigable balloon, "Le Paix," in Paris, on May 11th, have caused universal consternation, all the more vivid, on account of the interest in airships awakened by the experiments of M. Santos Dumont. As will be seen by announcements in another part of this journal, the subject of the Severo navigable balloon will form a substantial part of the programme of the next meeting of the Aëronautical Society on July 17th, when the Brazilian Minister, accompanied by the staff of the Brazilian Legation, will honour the Society by his presence. We will, therefore, refrain from further comment on the lamented death of the ingenious Brazilian politician in the present issue of the journal, since the proceedings of the forthcoming meeting will be duly chronicled in the October number. An illustration of the Severo airship is, however, appended. It will be noticed that in the picture the motors are not shown, so that the symetrical outlines of the novel combination of balloon and car in one body may be the more manifest.

Recent Lectures on Aëronautical Subjects.

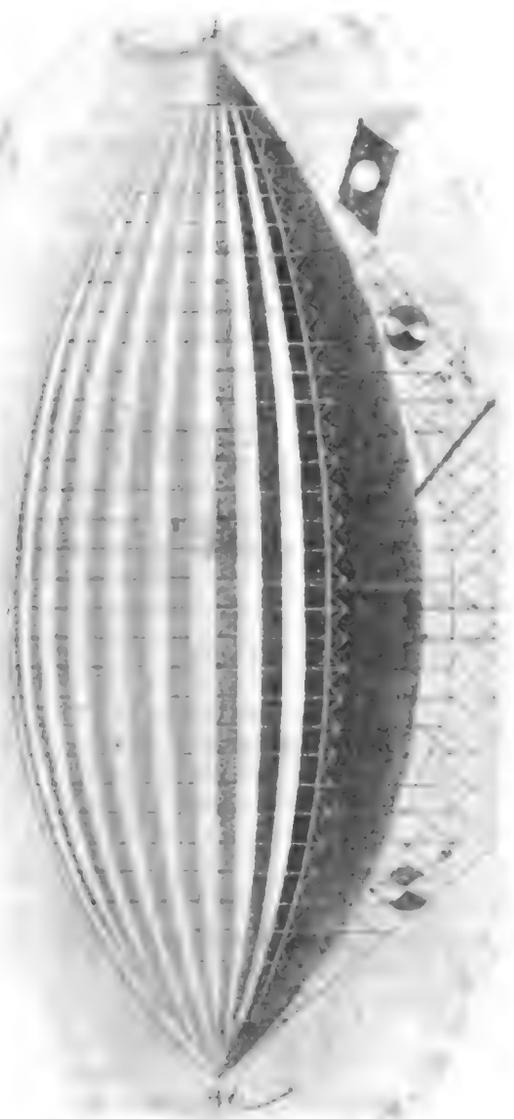
1.—SCIENTIFIC OBSERVATIONS AT HIGH ALTITUDES.

By the Rev. J. M. Bacon.

There could be no more striking example of the growth of interest in Aëronautical matters, than the fact that that eminently practical Society, the Society of Arts during last session devoted two Wednesday evenings to papers on aëronautical subjects, the first on scientific observations at high altitudes, being delivered on January 22nd, by the Rev. J. M. Bacon, the second on "The Use of Balloons in War," on February 21st, by Mr. Eric Stuart Bruce.

At the commencement of Mr. Bacon's paper he gave some of his experiences as to the varying directions of aërial currents at differ-

Digitized by Google



The "Peace" Balloon of Senhor Augusto Severo.

Digitized by Google

ent altitudes, experiences which show how dependent the aëronaut is upon sight of the earth for an estimation of the direction of the course of the balloon. On one occasion, starting from the Crystal Palace, with only a light air, the aëronauts entered mist at less than twice the height of the North Tower, at which point they determined their course as lying over the body of the Palace and on into the west. Then the balloon mounted rapidly to some 4,000 feet, and was cut off from all view of earth by a "tossing sunlit cloud-floor." When the balloon descended two hours later, it was thought that a landing would be effected in Hampshire or Berkshire, but contrary to all expectation, the aëronauts found themselves over the sea at the mouth of the Thames, for the balloon had been headed back by a fast upper current in the opposite direction to the current near the ground. On the occasion of an ascent from Newbury, when the balloon had got out of control, the aëronauts drifted for 10 hours at a height between 4,000 and 7,000 feet above a universal cloud stratum. The descent was made at Neath, Glamorganshire, where the wind was blowing half a gale. It was estimated that in its voyage the balloon was either blown out to sea and brought back again by an opposite current, or else for the first sixty miles the wind at the altitude at which the balloon was travelling was blowing at a rate of less than eight miles an hour.

The existence of currents travelling in different directions at different altitudes naturally suggests their utilization for the purposes of aërial navigation. Mr. Bacon appears to have made at least one successful attempt at their utilization. "It was on a still August afternoon that the intelligent following up of two diverse currents resulted in our steering our balloon, which I had equipped for signalling purposes, with a 'collapsing drum' across the entire stretch of Salisbury Plain, so that almost beyond my hopes I passed immediately over the military camps on the Plain and exchanged signals with them." It is to be regretted that Mr. Bacon did not furnish the exact details of this interesting manœuvre, as examples of steering a balloon's course by the use of diverse currents are very scarce. Speaking further on the subject of the horizontal currents, Mr. Bacon says "not unfrequently it is possible to determine that the course of horizontal air currents even up to a considerable height are being influenced by the nature or conformation of the surface of the earth immediately beneath. I have, for example, met with numerous windings of an estuary or river valley, and on one occasion, at a height of a thousand feet over Kent, it was impossible to resist the conviction that we were for some miles strictly following a chalk ridge."

An interesting observation, and one that suggests further research, is the uncertain courses of minor air streams of air. While the balloon was being carried with the more sluggish current a number of small parachutes were dropped at frequent intervals and carefully watched. These would commonly attend the balloon for a little while, until getting into some minor air streams, they would suddenly and rapidly diverge at such wide angles as to suggest that crossing the actual course of the balloon there were side paths down which the smaller bodies were wafted.

Mr. Bacon suggests that some of the caprices of temperature experienced in balloon voyages are caused by the more slender currents. Comparatively high temperatures are of not unfrequent occurence at considerable heights. These may be due to warmer wandering rills. Here, again, is scope for definite research.

It is suggested that haze is largely due to the commingling of air streams. "These must surely favour the formation of water dust in the atmosphere. We see evidence of this on the mountain sides; again, in those belts of mist lying across open country where opposing air currents meet and mingle; possibly, too, in the murky veil which gathers about a thunder cloud, and due, presumably, to the conflict of those contrary currents of widely differing temperature, which have been held to be in part, at least, the cause of such storms."

Some observations made as to the presence of dust in the atmosphere are not without interest. It is somewhat surprising to hear that on a still May afternoon, at 2,000 feet above Kingston, the air was found more heavily charged with dust than was the case with the air of the London streets the next day. But, perhaps, it is still more surprising to hear that the purest sample of air collected by Mr. Bacon, was at the open end of the Aldersgate platform of the Metropolitan Railway! Another example of the height to which dust penetrates was afforded in August last, when, at half a mile above the city, the dust, though somewhat less in quantity, was far more abundant than on the ground within the enclosure of Stamford Bridge in the forenoon of the following day.

Some interesting facts concerning Mr. Bacon's acoustical experiments from balloons

are recorded in his paper. On August 13th last, two gun-cotton charges were fired over London from a balloon, one over Soho Square at an altitude of 2,000 feet, the other four minutes later over Grays Inn Road. The balloon was travelling with a gentle breeze from the South-West, and at the altitude attained the air had grown more humid with an accession of moisture that declared itself in copious rain the next day. It was observed that "(1), in the case of each report the number of observations recorded against the wind greatly exceeded those recorded up or down the wind; (2), the longer sound ranges were chiefly in directions lying athwart the balloon's course; (3), certain quarters, neither particularly near, nor particularly quiet, would seem to have been accessible to the sound waves as by some special channel."

Mr. Bacon thinks that in certain conditions of atmosphere there are aërial sound channels through which sounds are momentarily conveyed with abnormal intensity. "A remarkable instance of the casual passage of sound was afforded as day broke, in one of the voyages already referred to. It was over the quiet pastures of Kent, with no sounds in the air save the first awakening of bird life. Suddenly, and for a brief second only, voices engaged in conversation whispered (I can use no other expression) in our ears, yet we were a quarter of a mile in the sky, and the speakers were not within view."

2.—THE USE OF BALLOONS IN WAR

By Eric Stuart Bruce, M.A.

At the commencement of the lecture, Mr. Bruce said that the object which stimulated the practical invention of the balloon was its use in war. He said practical invention, because in theory the balloon dates back as far as the elucidation of the principle of the pressure of fluids by Archimedes of Syracuse. But it was its use in war which fired Montgolfier, the paper-maker of Annonay in 1773, to fill his paper bags with heated air, and Charles, the Parisian, in the same year, to eclipse the fame of the former by the invention of the gas balloon. Ten years after the experiments of Montgolfier and Charles, balloons were first used by the French Government. It was Guyton de Merveau who first suggested their use to the Committee of Public Safety; and the first experiments were so successful that a regular company was formed called "Aerostiers," and the School of Ballooning, established at Meudon. The first military balloon made was called the "Entrepenant." This was used at the Siege of Maubenge and Charleroi, also at the battle of Fleurus. On this latter occasion it is recorded that the balloon remained in the air 10 consecutive hours, every movement of the enemy being seen and signalled. It was again used at the Seige of Mainz. In 1796 the French Government manufactured some more war balloons, which were sent to the armies of Dusseldorf and Stuttgardt. Altogether, it would seem that better work with captive balloons in war was done at that early period than during the whole time which elapsed between those wars and the South African campaign, in which the use of the balloon was so conspicuous.

Concerning the question of the chance of a balloon being struck by the enemy's fire; to illustrate that, a balloon may be perforated with bullets in its lower part, and yet remain in the air owing to the upward pressure of the hydrogen gas; the lecturer perforated a small captive balloon over and over again in its lower part with a steel needle, and yet the balloon remained in the air throughout the evening. It was mentioned that many of the balloons at Aldershot which had been at the seat of war showed signs of the bullet perforation. Several facts showing the usefulness of the observation balloons in the recent war were then quoted, stress being laid on the discovery made from the balloon that the British troops were about to march into a death trap at Spion Kop. Concerning that observation, Mr. Bruce said, "on reflecting on the narrow escape of a great disaster averted by the balloons at Spion Kop, the thought forces itself upon the mind what would have happened had it not been for that happy aërial observation at that critical moment? What might have been the effect of depression on our army and exhilaration on the part of the Boers? I will not go so far as to hint that Ladysmith might have fallen, for the history of the sieges of Ladysmith and Mafeking show how difficult it is to find the limit of British endurance; but I will say that this brilliant achievement of the balloonists facilitated the relief of the hard-pressed garrison." Concerning the use of the balloon at Fourteen Streams, where it worked continuously for fourteen days with one inflation; it was pointed out that this was the best possible test of the efficiency of the retentive power of gold-beater's skin. "Much is said at the pre-

Digitized by Google

sent moment about the backwardness of the British nation in aëronautical matters. In answer to such statements, I would express my opinion that at the present moment, no other nation in the world could have produced a balloon of the same size that would have thus worked for thirteen days with one load of gas."

Speaking of the utility of a free balloon in war, the lecturer urged that its usefulness would be largely increased if it could be steered against a wind of considerable power. "Aërial warfare in navigable balloons is the prophecy of the past. Tennyson has written of 'the nation's airy navies grappling in the central blue.' But science, as yet, has not produced a navigable balloon capable of fulfilling this vision of fancy, and even if it had, it is probable that our international convention would prohibit the discharge of explosives from aërial vessels, 'The rain of ghastly dew' as being too barbarous even for modern warfare. Though I do not wish to speak in defence of such a system of warfare, yet I would ask whether torpedo warfare, which is generally accepted, is not equally uncivilised. But if never used as a floating battery, a balloon that could navigate the air against even a moderate breeze would be a great advantage to an army for scouting purposes."

The various experiments with navigable balloons, from the steam balloon of Giffard to the petroleum motor balloon of M. Santos Dumont, were then described and illustrated by lantern slides. With regard to the wind forces overcome by M. Santos Dumont, it was stated that when these were examined they amounted to about 4½ to 5 metres a second, an advance of a metre and a half per second on the experiments of Captains Krebs and Renard in 1885. It was pointed out that the latter had only 9 horse-power, whereas the former had 20 horse-power.

"With present knowledge a balloon can be steered in calm weather, but the question how to navigate it in any wind is absolutely unsolved. This working model shows you the principle of a navigable balloon. In the calm air of this room, by means of its rudder and screw, we can navigate it where we wish. To further the solution of the problem of a navigable balloon, capable of being useful in war, careful quantitative experiments will be more useful than any number of the more sensational journeys under the conditions of money prizes, in which the scientific desiderata are not sufficiently taken into account. When I say this, I do not belittle the work of such heroes of aerial navigation as M. Santos Dumont. By his bravery and perseverance he has winged the petroleum motor, and shown possibilities for the future. But in the future the problem must be more seriously attacked than for the purposes of sport. The time has arrived for the Endowment of Aëronautical Research. In conclusion, may I express the hope that before long the British nation will apply to aëronautics some of its engineering skill, and launch into the air a navigable balloon which will be able to overcome a sufficiently strong wind to add to the resources of our national defences." (Applause.)

The Mellin Airship.

We are indebted to the courtesy of Messrs. C. G. Spencer and Sons for the following details of the Mellin Airship, which has been designed and constructed by that firm.

The balloon is constructed of varnished silken fabric, similar to that used for ordinary balloons. Its capacity is about 20,000 cubic feet, length 75 feet, maximum diameter 20 feet. It weighs, with netting, 290 lbs.

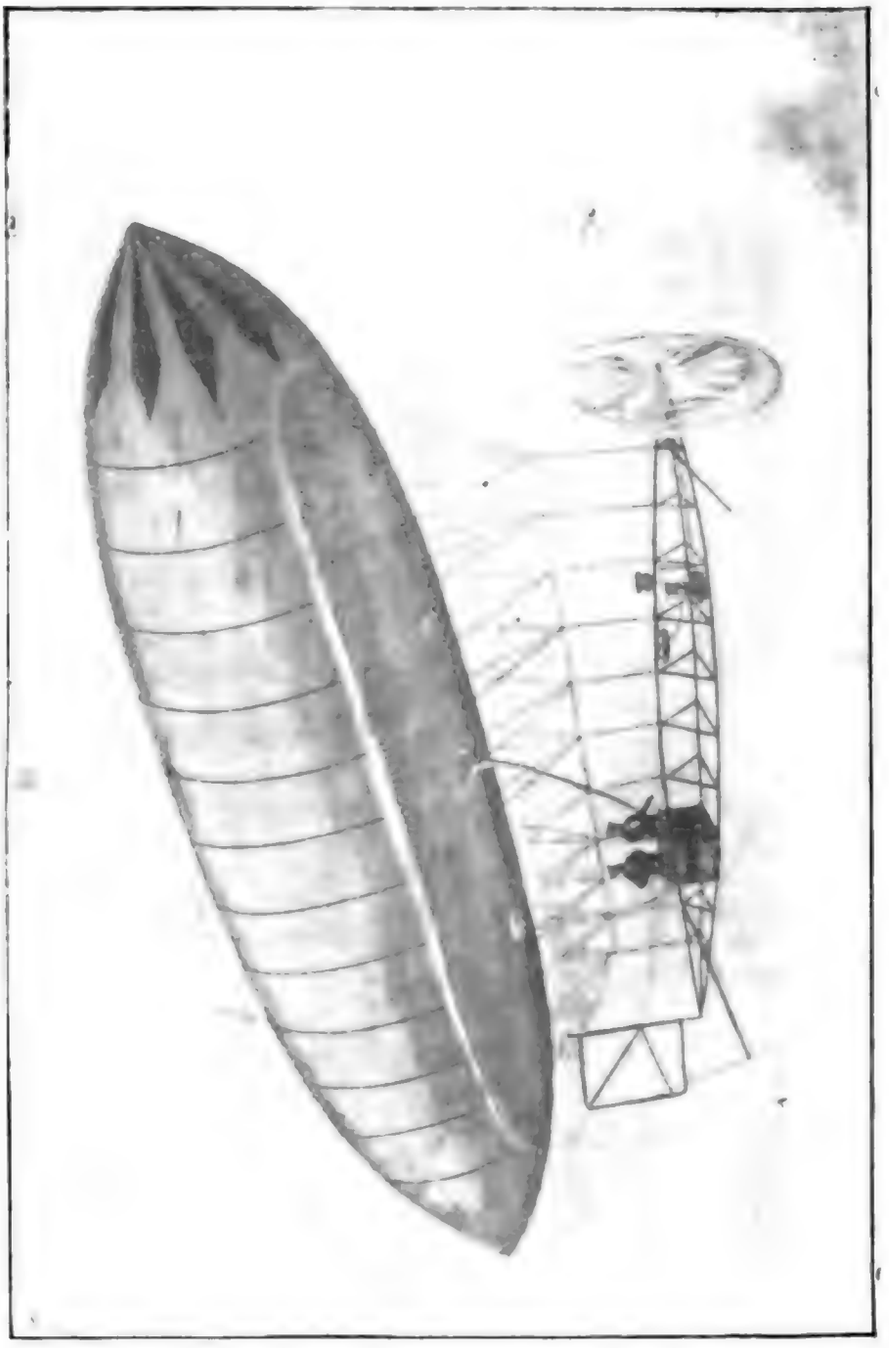
The bamboo framework which contains the motor, gearing, car, etc., is 42 feet long. It is built with triangular supports, and is rigidly built with steel wire stays. It is swung 10 feet below the balloon, and the motor is 20 feet from the escape valve.

The motor is a Simms Petrol Motor, with water-cooled head, and magneto ignition. It runs at 2,000 revolutions per minute, and turns the propeller at one-tenth the speed.

The propeller is made of light pine wood wrought to the curve as approved by Sir Hiram S. Maxim. It weighs 28 lbs., is 8 feet in length, and the blades are 4 feet wide at the ends.

The mechanism comprises a steel shaft from the clutch, which is attached to the motor, working a steel pinion, which revolves at the full speed of the motor. This works a gun-metal spur-wheel of ten times its diameter, which carries the propeller shaft. Ball bearings are provided throughout. The exhaust from the motor is surrounded with wire gauze on the Davy lamp principle, to avoid danger through the flame coming in contact with any escaping gas. A starting gear on the free wheel principle is provided, and the necessary tanks for water and petrol with copper tubes, radiator, etc. This work has been carried out by Mr. F. J. Baynes, engineer, of Highbury, under the direction of Mr. Spencer.

Digitized by Google



The Mellin Airship.

Digitized by Google

The car, for the aëronaut, consists of a platform on bamboo supports surrounded by open network. At the car are concentrated the cords controlling the clutch (which throws the engine and propeller out of gear), the electric switch (by means of which the motor can be stopped), the rudder lines, the balancing trail rope, the blower (for pumping air into the balloon to control its distention and equilibrium), the ballast control cords, and the valve lines.

Hydrogen gas for inflating the balloon is to be made on the spot by means of the gas generating plant supplied by C. G. Spencer and Sons.

The Mellin airship is being exhibited at the Crystal Palace by the Spencer brothers, who may certainly be congratulated on the success of the first experiment, on June 23rd, when the balloon was steered three times round the enclosure. It can no longer be said that the British nation is behindhand in the very latest departures of aëronautics.

The Berlin Congress of the International Aëronautical Commission.

The Congress of the International Aëronautical Commission held at Berlin from May 20-24, under the Presidency of Professor H. Hergesell, was an unqualified success. Amongst the most interesting subjects of discussion which occupied the attention of the scientific aëronauts of various nationalities, was that of ascents to extreme heights.

PROFESSOR CAILLETET'S NEW APPARATUS FOR INHALING OXYGEN.

The discussion on high ascents was opened by a paper by Professor Cailletet (Paris), who introduced his new apparatus for inhaling oxygen, when reaching very great heights. The chief disadvantage in the method of inhaling oxygen generally in use now consists in having to carry the gas to be inhaled in a compressed condition. For this purpose one needs capacious, strong and heavy reservoirs, as with each breath we consume several litres of oxygen. If oxygen is carried in a fluid condition, which has about the same density as fluid water, comparatively speaking, one only needs a small reservoir, which may assume any desired shape. Monsieur Cailletet avails himself of a pear-shaped metal flask with a double set of walls, the space between them being filled with air. The exterior wall has on its surface a bright polish to prevent the oxygen from coming into contact with heat conductors, also to prevent radiation so as to keep it in a fluid condition. By the introduction of air by pressing an ordinary india-rubber ball the fluid oxygen is driven through a narrow metal tube projecting from the flask, into a detachable tubular apparatus of extraordinarily large surface. Inside this apparatus the fluid oxygen evaporates and passes as a gas through the rubber tubes into a large reservoir, made of the same material, expanding easily, and is safeguarded against the dangers of explosion by a strong net, tied to a ring of the basket. From this reservoir the oxygen is transmitted into the rubber tubes of the breathing mask after having been mixed with ordinary atmospheric air, by means of tubes adapted to the main tubes in sharp angles. The mask is kept before the face by elastic bands, so that the inmate of the balloon is forced to inhale continuously an air which is rich in oxygen. Monsieur Cailletet thinks this to be of great importance. At the lower end of the mask there is a waste air pipe leading out the exhaled air. It is ingeniously provided with a safety-valve of simple construction, and arranged so as to close by itself when aspirating. To prevent the exhaled vapour on condensing from freezing, and to keep the waste air pipe in working order, the latter must be kept under the coat.

THE RECENT HIGH BALLOON ASCENT OF DR. SÜRING AND DR. BERSON.

Dr. Süring next treated of his ascension on July the 31st, 1901, which he undertook in company of Dr. Berson, when the height of 10,800 m. was reached; claimed by them to be the extreme limit yet reached by the aëronaut. The adventure and the scientific results obtained during this expedition having been already fully dealt with, the speaker said he would dispense with dealing with this side of the question. On the other hand, it might prove to be helpful to speak on some points of general interest concerning ascents to extreme heights. The experience gained in the aforesaid expedition may be of service in

Digitized by Google

future undertakings of a similar character. It is to be hoped that in the future the experts will attach greater importance to these ascents, and that these undertakings will occupy a larger space in their programme than has hitherto been the case. As to the physiological side of the question we may, on closely studying foreign and German ascents, distinguish three stages. During the first of these stages the excitement exceeds considerably the phenomena of height-sickness proper, resulting from want of oxygen. In such a state of excitement, one does not know, perhaps, the real state of the height-sickness, and this naturally becomes an exceedingly critical matter when the dangers of a mishap become imminent. The regrettable issue of the "Zenith" expedition in the year 1874, is no doubt to be traced to this, to a large extent, at any rate; for it is by no means a mere chance that Gaston Tissandier, the experienced and therefore cool aëronaut, survived, whilst his companions Grece, Spinelli and Sivel fell victims. In the conduct of the latter throwing, senselessly, ballast after ballast overboard, so thus sailing helplessly, nay, unconsciously, towards their speedy ruin, we can distinguish the second, more dangerous stage, that of confusion. By systematically inhaling oxygen, this state of excitement leading to confusion and imminently dangerous conduct can be warded off by aëronauts of ordinarily cool disposition; whereas, it is evident that a state of enervation with signs of relaxation cannot be completely prevented. Notes are illegibly written in the wrong place, the eyes refuse their services, the slightest exertion results in a dangerous weakness, and, finally, the whole organism falls a victim to an inevitable need for sleep. But, also these illnesses may yet be overcome to a certain extent if greater precautions are taken in future ascents, if the aëronaut avoids all exertions, all excitement, sleeps sufficiently, undergoes a still more systematic inhaling of oxygen, begins earlier with it and protects himself sufficiently against cold.

THE PHYSIOLOGY OF ASCENTS.

Dr. von Schrötter was next heard on the "Physiology of Ascents." He had made systematic studies on the influence of great reduction of air on the human organism. The experiments were made in the pneumatic cabinet of a Berlin hospital, in which the pressure could be reduced to 230 mm. mercury. These experiments showed that even in the smallest pressure attainable—the most of the experiments having been made, however, at 269 mm. pressure—the inhalation of oxygen had the effect of invariably bringing back the full bodily and intellectual capacities after a certain time varying according to individual. The pathological phenomena are also individually different. The speaker felt pains as if girded too tightly with a belt, and general symptoms of relaxation, which he explains as follows: According to Dalton's law, the quantity of disolved nitrogen in the blood stands in a certain proportion to the outer pressure of air. If the pressure of air is suddenly diminished, more nitrogen leaves the body than would be possible under normal conditions. The infinitely small bubbles of nitrogen collect in the cells into large bubbles, causing embalite process, which latter disturbs the nourishing of the nervous centres and produces relaxation. Also the hindrance of equalization of air pressure has a most painful effect on certain parts of the body, which do not, however, endanger life directly. No marked influence is shown on the number of red blood corpuscles greatly reducing the air, provided this is only momentary.

ORNITHOLOGICAL OBSERVATIONS FROM BALLOONS.

The Chief Lieutenant von Lucanus (2 Regiment of G. Uhlans) made some interesting remarks on ornithological observations from balloons. The Inquiry, which the commandants of the Prussian and Bavarian Aëronaut Division, and the President of the International Commission had made at the instigation of the speaker, had resulted in the assumption that 401 m. was the limit to which birds rise above the surface of the earth, and that there was, therefore, no ground for the assertion of a well-known zoologist that there were birds raising themselves 8,000 m. above the surface of the earth. The lowest limits of the clouds seem to be the highest of birds' flight. More comprehensive observations are yet necessary, especially in countries where many birds of passage cross, as, for example, in Italy.

THE MEASUREMENT OF ELECTRICITY IN THE AIR FROM BALLOONS.

Professor Ebert, of Munich, spoke on "Measuring the density of electricity" from the balloon. Quite lately it was found that the air possessed certain compositions charged

Digitized by Google

with electricity. They are called electrons, and answer to the description of the solution products obtained in the process of electrolysis. The proof that such electrons exist can be had by the dispersing apparatus on the principle of Professor Elster, and of Geitel. It will be of great importance for physical geography to solve the question as to right proportion of density of positive and negative electrons in the air, according to the various heights. But the Professor had also some objections to make against the apparatus in question. He had succeeded in making the necessary alteration whereby errors he had referred to could be avoided. By means of an aspirator, a certain defined quantity of air could always be conducted past the dispersing body. This resulted in a second advantage: namely, the absolutely accurate measuring of the quantity of free electricity contained in a cubic metre of air.

In the course of the discussion, Professor Elster, of Wolfenbüttel pointed out the fact that doubts of the actual presence of electrons were still prevailing in some individual circles. Through information obtained from the so-called "Jonenfang" expedition, these doubts are dispelled. Professor Ebert himself had always found the theory confirmed in his experiments, however much he varied them. Dr. Caspari, of Berlin, has discovered and imparts to us interesting connections between density of electrons in the air and height-sickness. He had made these discoveries while on a physiological tour in the high Alps. It appears that it is not the absolute quantity of electrons which causes these physiological influences, but the proportionate superabundance of the electrons. Geheimrath von Bezald pointed out that the relations between sirocco and density of electrons are being studied at his suggestion by Professor Germak, of Tunsbruck. The air descending from great heights when the sirocco blows, carries with it these electrons in large quantities into the lower layers of air. It is thought to be most probable that relations exist between height-sickness and the well-known injurious effects of the "sirocco" wind on the organism of men and animals.

Dr. Linke, of Potsdam, is then called upon. He is the well-known companion of Captain Siegsfeld, and accompanied him on the latter's fatal journey. Dr. Linke reported on the measuring of electricity in the air whilst in the balloon.

On suggestion of Professor Bornstein, of Berlin, and later of the Royal Prussian Meteorological Institute, Dr. Linke had carried through a large series of ascensions to about 6,000 m., and had studied on the one hand the potentials, and on the other the electric conductivity of the air. He had obtained confirmation of former results; namely, that the electric potential of air always showed positive value, but always slower, the higher one ascended. Of a mechanical interest may be the fact that the vertical motions of the balloon give rise to errors in the measurements of the electrometers, which can only be avoided partially. If the balloon is ascending or has only just stopped, one finds quite different despersing values, which leads us to suppose that the balloon must itself have something to do in the matter. The speaker warned against entrusting these difficult measurements of despersion to inexperienced observers.

THE BALLON-SONDES EXPERIMENTS.

In connection with the ballon-sondes experiments, there was a paper by Mr. Eric Stuart Bruce, the Honorary Secretary of the Aëronautical Society of Great Britain, on the Metroparachute, which he has designed to increase the usefulness of the ballon-sondes. As this instrument has been fully described and illustrated before a meeting of the Aëronautical Society, and the proceedings published in the July number of this journal, 1891, it will not be necessary to make any further reference to the invention.

Regarding the monthly ascents of the ballon-sondes, Professor Hergesell stated that it had been resolved that the ascent of at least one balloon at each respective place, was to be made an hour before sunrise, so as to prevent any inaccuracy in the registrating apparatus through radiation, and so that the balloon can be seen when alighting. In these ascents the Teisserenc de Bort Thermograph would be used.

THE HARGRAVE FLYING MACHINE.

On May 10, the members of the Engineering Association of New South Wales viewed the flying machine that is being made at Woollahra Point, Sydney. On this occasion

Mr. L. Hargrave said: The presumption to-day is that all engineers have read about the experiments made by Maxim, Langley, Chanute, Walker, Wright, Pilcher, Lilienthal, Kress, Phillips, and others; and have so far assimilated the matter that it is now common knowledge that power-driven machines will glide through the air supported by surfaces of metal, wood, and fabric. The reason that no machine has yet made a flight of any length that might be called successful is that the relations of weight, power and area have not been rightly combined. Nature shows an infinitude of combinations, and it is safe to say the variety of hand-made machines will be equally diverse. The machine before you may not be one of the successful fliers, but it is hoped that it will push the art a stage further forward.

The first thing to provide for is safety It is worse than useless to take *any* risks. A man may spend years in getting to the trial stage, and then break his neck by being too adventurous. The method of procedure in this case is to float the machine on water, drive the engine for all it is worth, put the horizontal rudder in the lifting position, and it either flies or it does not. If it does rise from the water, two things have to be attended to; the steering up and down and from side to side; the up and down needs the most care; the steering in azimuth is to be solely effected by the movement of the principal weight, and it is further complicated by the listing due to there being only one screw, but direction is unimportant, as, off this point (Woollahra Point), there is a clear track on most courses.

I will now give dimensions of the various parts:—

Main float is 25 feet 7¼ inches long, 10 inches diameter under the boiler, and tapers to 4 inches at the tail and 6¾ inches near the bow. It weighs 25 lbs.

The balance is kept whilst afloat by two outriggers, they are each 5 ft. 6 ins. long, and 6¼ ins. diameter, displacing about 60 lbs. each. The width outside the outriggers is 7 ft. 6 ins., the two outriggers weigh 5 lbs.

The framing consists of 2-inch tin tubes.

Boiler consists of 191.35 feet of copper pipe; it is arranged in a 4 stranded plain coil 10¾ inches diameter. The bore of the pipe is ·27 inch, and thickness of metal ⅛ mill. The whole of it has been turned down from stock Sydney sizes. There are 13.5 square feet of heating surface. The safety valve is on the water end of the boiler and the steam pipe is ½-inch. The coil and mountings weigh 13½ pounds; and a sheet of asbestos card forms the casing.

Fire, is a sort of "Primus" lamp.

Fuel, kerosene.

Engine, is a 2 cylinder Whitehead, 3½ inches diameter and 3¾ inches stroke cut off at .7 by 1¼-inch piston valves driven by one eccentric. Shaft is 1 inch.

Feed pump, same stroke as engine, .52-inch ram; stroke can be regulated and pump worked by hand to start the engine.

Screw, made of clear pine of the Mangin-Walker-Hargrave type, 6 feet diameter, with provision for altering pitch, diameter, and area. Pitch angle for first trial is 30°. Total area of 4 blades is 6¼ square feet. Boss of screw is aluminium. The wood is sewn together saddler fashion. Weight of 4 blades is 5½ pounds.

Rudder, horizontal, 5 feet by 1 foot right forward.

Lifting surface, 50 yards of muslin 38 inches wide weighing 9½ pounds, arranged in two 3-decked cells, say 470 sq. ft. surface.

The total weights at present are:—

Engine, boiler, floats, framing, screw, &c.	94	pounds.
Water	55	,,
Kerosene	3½	,,
Muslin	9½	,,
Self	162	,,
Total	324	pounds.

leaving 147 pounds available for booms and rigging for muslin and rudder, before the load on each square foot is one pound.

Mr. Hector Kidd, the President of the Engineering Association, wished Mr. Hargrave success on behalf of those present.

NOTES.

New Aëronautical Instruments.—At the recent Aëronautical Congress at Berlin, some new instruments of great promise for aërial research were exhibited. Amongst these was the gyrometer, of Herr Gradenwitz. This apparatus gives, at a glance, the direct speed of the wind in metres and per second without having simultaneously to look at the watch. The apparatus has, at its axle, a cylindrical glass vessel, closed up and half filled with glycerine, to the exterior of which is adapted a ring-shaped scale and ordinary wind gauge. When the apparatus revolves, the sur-

Digitized by Google

face of the rotating fluid assumes the shape of a rotary paraboloid, which sinks in depth according to the speed of the revolution.

Professor Ebert exhibited an apparatus for the measurement of horizontal intensity of the earth's magnetism from the balloon. It is an improvement on Heydweiler's apparatus, and enables the observer to notify the changes in the intensity without the knowledge of the direction of the astronomical and magnetic meridian. This apparatus is of extreme sensitiveness, and promises to be of the highest scientific value.

The Variation of Temperature with Height.—In an excellent article on scientific ballooning appearing in "Nature" in January last, Mr. N. Shaw discusses the question of the variation of temperature with height. Speaking of the scientific use of the balloon, he says, the primary meteorological question to be determined by balloon ascents is the rate of variation of temperature with height. It was thought that Mr. Glaisher had settled the point, but the subject has been re-opened in Berlin, which is now the centre of scientific ballooning, on the ground that the thermometers used by Mr. Glaisher were not sufficiently ventilated or screened from radiation. In Dr. Berson's investigations, M. Assman's ventilating thermometers were used, and care was taken to make the circumstances of ascent comparable with those of Mr. Glaisher's memorable ascent of 1862. As Mr. Shaw points out, the precautions were carried so far as making an ascent from the Crystal Palace itself on September 18th, 1898, while a simultaneous ascent was made at Berlin to make sure that the differences of the observations were not due to climatic differences between the air over Germany and over England. Further trial was made by the reproduction of Mr. Glaisher's arrangements from his description, and the comparison of its readings with the Berlin arrangements. As the result of the observations, Dr. Berson concluded that the difference of the observations was due to instrumental errors in Mr. Glaisher's observations. Mr. Glaisher's observations led to the conclusion that a constant temperature is indicated at no very great height, whereas Dr. Berson's figures show increasing rate of fall with height. "The difference in the results is one of fundamental importance. Berson's numbers clearly do not go to the end of the matter, for, with a little play of the imagination in the region of Extrapolation his results bring absolute zero within sight of the very moderate height of some thirty miles, whereas 68° C. is the lowest temperature recorded in the flight of the unmanned balloon, Cirrus, from Berlin, which is reported to have reached a height of 18,000 metres. This, by a curious coincidence, is identical with the lowest temperature recorded at the earth's surface. It was registered at Werchojansk, in Siberia, on January 15th, 1885; a still lower temperature—70° C. is given in the Meteorologische Zeitschrift for June, as registered by the apparatus of an unmanned balloon started from Vienna on January 10th of last year."

The Application of Balloons and Kites to Wireless Telegraphy.—Mr. Marconi, in his recent lecture on wireless telegraphy at the Royal Institution mentioned that his late endeavours to utilize balloons and kites for long distance transmission of signals had been unsuccessful, owing to the wind force experienced at the elevation of the balloon or kite. He further condemned the use of aërial methods in a short interview with the Honorary Secretary of the Aëronautical Society after the lecture. But it should be pointed out that the resourcefulness of a Baden-Powell appears to have accomplished what even the illustrious applier of wireless telegraphy has failed to bring about, and to have made his kites of undoubted usefulness in conveying wireless telegraphic messages to moderate distances. Possibly in its present stage of development balloons and kites may not be of use in transmitting messages across the Atlantic, owing to the detrimental effect of wind on the etherial waves. But this fact does not quickly dispose of the whole question as to the use of kites and balloons in connection with the Marconi system. For military purposes, where portability is of consequence, the kite as a means of raising the Marconi apparatus has been proved to be of service in the experiments of the President of the Aëronautical Society to which allusion has already been made. At any rate, Mr. Marconi's confessions display the weaker side of wireless telegraphy, which will have to become independent of the wind if it has to enter the lists in competition with wire telegraphy. The weaknesses of telegraphy through space are certainly, at present, sufficient to justify the military authorities in retaining the old resources of visual signalling.

The St. Louis Airship Competition.—It is officially announced that the St. Louis Exhibition has been postponed to

Digitized by Google

1904. At a meeting of the aërial committee in April last, it was decided that the course should take the form of the figure 8. The grand stand is to be located near the intersection of the lines. The starting point will be at one of the loops, and after the entire outline of the figure is traced, the finish will be made as stated, near the connecting points of the loops, in view of the spectators. Another point decided was that in the contest only one airship will be started at a time. The race will thus be against time rather than against another craft. The Committee also discussed the sum which is to be reserved for subsidiary prizes in addition to the $100,000 grand prize. The sum of $50,000 is to be divided into ten or twelve parts, each contingent upon the performance of some accomplishment on the part of an air vehicle. For instance, prizes will be offered for various evolutions of airships, upward, downward, backward and forward, circular or angular movements. It appears, however, that the aërial committee have forgotten the most important condition in an airship competition, which is the wind force. It is obvious that the only way in which fairness can be given to such a competition is to award the prize to the competitor who overcomes a certain wind force. Without such a condition there can be no true competition. In the interests of aëronautical science it is to be hoped that the committee will reconsider their decision.

The Sheffield Fatal Parachute Accident.—Few persons can approve of the practice of dropping girls from balloons by means of parachutes to add to the sensation of a professional balloon ascent. The most recent victim to such an undesirable performance was the unfortunate girl who lost her life at Sheffield on May 20th, in falling from a balloon with a parachute which did not open. The opinion of the jury at the inquest in condemning such performances, will be generally endorsed. Perhaps, however, it is a pity that the jury did not add that the accident was an instance of the abuse of the invention of Leonardo da Vinci, and that the legitimate use of the parachute is for saving life in an emergency. The principle of the parachute, depending on the resistance of air, is, in fact, the only lifebuoy of the balloon. In the past it has been the means of saving life. As early as 1803 a case of its usefulness was recorded. Jordarki Kuparenti, a Polish aëronaut, ascended from Warsaw in a fire balloon. When the balloon attained a great height it caught fire, and certain death must have been the aëronaut's fate, had he not been provided with a parachute, with which he made his descent from the terrible situation in perfect safety.

The Collapse of the No. VI. Santos Dumont Balloon.—No one can deny that the No. VI. balloon did M. Santos Dumont good service. It formed the aërial chariot on which the bold Brazilian rounded the Eiffel Tower and won the Deutsch prize. The many evolutions which it accomplished last year in the Parisian capital exposed it to considerable wear and tear, but since the more palmy moments of the Brazilian aëronaut, it underwent a ducking in the Mediterranean Sea, not calculated to improve its condition. Since that episode, it has been on exhibition, blown out with air, inside the Crystal Palace, under conditions that would be trying to the varnished surface of any balloon. It was not a matter of surprise to experts to hear that on examination shortly before the advertised trips of M. Santos Dumont, the balloon was found to be hors de combat. Unkind rumours were at first current that the holes and tears was the malicious work of an adversary. Expert opinion, however, soon disipated such imputations. The very fact of hanging a balloon filled with air in the great glass house, where it was exposed to a heated atmosphere, was not calculated to prolong its life. The writer, some years ago, had a small balloon suspended for exhibition purposes in one of the Courts of the Crystal Palace. One day, after a few weeks' exposure, when it was being blown out with air, it fell to pieces. The collapse of the Santos Dumont balloon is, therefore, not without precedent.

Foreign Aëronautical Periodicals.

(In this list a selection of some of the more notable articles is given.)

L'AËRONAUTE (Paris).

January, 1902.—Rapport du Voyage de M. Turbiaux, Aéronaute du Ballon "La Poste de Paris," *Janvier*, 1871.

Digitized by Google

February.—Hélicoptère Ballé.

May. -- Projet de dirigeable de M. Le Docteur Mora.

L'AÉROPHILE (Paris).

January. — Portraits d'Aéronautes Contemporains: L'Ingénieur Forlanini (G. L. Pesce); Expérience d'Aéronautique sur le Méditerranéen (H. de la Vauix).

February. — Portraits d'Aéronautes Contemporains: Georges Bans (Emile Straus); "Le Voyage du Méditerranéen" (H. de la Vauix).

March. — Portrait d'Aéronautes Contemporains: GeorgeMangin(Henry deGrafligney); "Le Voyage du Méditerranéen" (Henry de la Vauix).

May.—"La Catastrophe du Pax."

ILLUSTRIERTEAËRONAUTISCHEMITTHEILUNGEN.

January, 1902.—Santos Dumont (H. W. L. Möedebeck); Die Verwendung des Luftballons in China Wahrend des Krieges, 1900-1901 (Hauptmann Neumann); Das Zeppelin 'sche Luftfahrzeug (Hugo Kübler); Die Elektrische Ladung das Luftballons (Dr. Franz Linke).

April.—Rudolf, Max, Wilhelm, Hans das Bartsch von Sigsfeld (V. Kleist); Vortrag des Dr. Linke uber seine Fahrt mit Hauptmann V. Sigsfeld nach Antwerpen—Les Ascensions de M. Santos-Dumont (G. Espitalier); Bildung und Konstitution der Wolken (Prof. W. Trabert); Wiener Luftschiffer—Zeitung—(Vienna).

March, 1902. — Flugmaschinen mit und ohne Ballon—Die Erste Luftballon fahrt in England.

April.—Grundgüge Der Praktischen Luftschiffahrt (Victor Silbaer); Der Kriegsballon in Südafrika.

May.—Der Kraftersatz in Mechanischen Princip Des Fluges (Carl Battenstedt).

June.—Der Congress in Berlin—Gar Catastrophe des "Pax."

Notable Articles.

January, 1902.

15. *Daily Mail.*—"Shall we Fly?"
17. *Engineer.*—"Travel in Air."
28. *Daily News.*—"Microbes in Upper Air."
31. *Engineer.*—"Travel in Air."

Feb. 1. *United Service Gazette.* — "Military Ballooning."
3. *Newcastle Chronicle.* — "Aërial Navigation."
4. *Daily News.*—"Balloon in a Gale."
7. *Engineer.*—"Travel in Air."
11. *Daily Mail.*—"The Pioneer of Balloons in Polar Research."
14. *Engineer.*—"Travel in Air."
20. *Westminster Gazette.* — "The use of Balloons in War. Why not under Aëronautical Research?"
21. *Engineer.*—"Travel in Air."
21. *Times.*—"The Wreck of Santos Dumont No. VI."
28. *Engineer.*—"Travel in Air."

Mar. — *Fielden's Magazine.* — "Recent Aeronautic Experiments."
7. *Engineer.*—"Travel in Air."
— *Engineering.*—"Santos Dumont Airship and Andree Balloon."
21. *Engineer.*—"Travel in Air."
25. *Daily Mail.*—Across Arabia by Balloon."
28. *British Journal of Photography.*—"Kite Photography."

Apl. 10. *Nature.* — "The Exploration of the Atmosphere at Sea by means of Kites."
18. *Engineer.*—Travel in Air."
— *Standard.* — "A Scientific Balloon Voyage."

May 2. *Engineer.*—"The Problem of Flight."
13. *The New York Herald.*—"The Fatal Accident to M. Severo."
21. *Sheffield Telegraph.*—"Fatal Parachute Accident."
26. *Daily News.*—"The Parachute Disaster Explained."
27. *Daily Chronicle.* — "First British Airship."
— *The Daily Graphic* — "A Scientific Balloon Congress."
29. *Daily Telegraph.*—"M. Santos Dumont's Airship—an unfortunate Accident."

Digitized by Google

June 7. *Invention.*—"Accident to the Airship."
11. *The Car.*—"The Motor Aerial."

Applications for Patents.

(*Made in April, May and June to 23rd.*, 1902).

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AERONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.

8016. April 5. LEON ROTHSTEIN. **An Air-Ship.**

8681. April 14. THEODORE HAAS. **Improvements in Flying Machines.**

8875. April 16. GEORGE KIRBY. **Improved construction of Flying Apparatus for use on Stages of Theatres and the like.**

9037. April 18. JAMES JENKIN WALES. **An Improvement for an Aerial Machine for Aerial Flight in any direction used.**

9706. April 26. ARTHUR HENRY PHILIP BLUNT. **Improved Flying Machine Propeller.**

10267. May 5. JAMES FRASER. **Air-Ships.**

10349. May 5. LA SOCIETE ANONYME POUR LE COMMERCE ET L'INDUSTRIE DU CAOUTCHOUC (Belgium). **A New or Improved Twin Balloon.**

10842. May 9. HERBERT ARTHUR LEVENS. **Improvements in and relating to Aeronautics and Aerostatics and the like.**

10816. May 10. WALTER ERNEST SYKES. **Improvements in or relating to Flying Machines, Air-Ships, or the like.**

11277. May 16. ARTHUR CHARLES SPENCER. **Improvements in Navigable Balloons.**

11616. May 21. JOSEPH DE LIPKOWSKI. **Improvements relating to Aerial Machines.**

11744. May 23. LARS JARSON ANDERSON. **Twin Balloon Air-Ship.**

11982. May 26. JOSEPH SIEBERL. **Improvements in Flying Machines.**

12222. May 29. ERNEST ARTHUR LE SUEUR. **Improvements in the Art of Aerial Navigation.**

12866. June 5. HORATIO FREDERICK PHILLIPS. **Improvements in or relating to Flying Machines.**

12985. June 7. FREDERICK WARNER JONES. **Improvements in the Construction and Methods of Propulsion of Ships for Water and Air Transit.**

13397. June 13. WILLIAM MACLEOD. **Tractors for Ships and Aerial Machines.**

13499. June 14. ALFRED KARL RUDOLF AUGUST KRAKOW. **Steerable Flying Machine.**

Digitized by Google

LIBRARY

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH.
AUG 4 1910

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain.

By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 24. OCTOBER, 1902. VOL. VI.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AËRONAUTICAL SOCIETY	55
THE PRESENTATION OF AN ILLUMINATED ADDRESS TO MAJOR B. F. S. BADEN-POWELL	55
GENERAL MEETING OF JULY 17th—	
THE "PEACE" BALLOON OF THE LATE SENHOR AUGUSTO SEVERO (*Portrait*)—	
(i). By Dr. CARLOS SAMPAIO	56
(ii). By ERIC STUART BRUCE, M.A.	59
THE VOTE OF CONDOLENCE WITH THE BRAZILIAN GOVERNMENT ON THE LAMENTED DEATH OF THE LATE SENHOR AUGUSTO SEVERO	60
REPLY OF THE BRAZILIAN MINISTER	61
"BALLOON ASCENTS IN THUNDERSTORMS." By the REV. JOHN M. BACON	62
NOTE ON "A PERFORMANCE OF THE BRISTOL WAR BALLOON DURING THE SOUTH AFRICAN WAR." By CAPTAIN H. B. JONES, R.E.	65
NOTE ON "THE CYCALA FLYING MACHINE." By Dr. CHARLES ZIMMERMAN	59
THE PRESIDENT OF THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN (*Portrait*)	66
THE BALLOON CENTENARY AT BATH	67
THE RULES AND REGULATIONS FOR THE ST. LOUIS AIRSHIP COMPETITION	68
OBITUARY—THE LATE SIR FREDERICK ABEL, BART.	71
NOTES—PROFESSOR LANGLEY'S EXPERIMENTS—THE JOURNEY OF THE MELLIN AIRSHIP ACROSS THE METROPOLIS—THE NAVIGABLE BALLOON SCHEME OF M. TORRES—THE INVESTIGATION OF THE ATMOSPHERE BY MEANS OF KITES—RECENT BALLOON VOYAGE OF COMTE HENRI DE LA VAUIX	72
REVIEWS—"AËRIAL NAVIGATION." By FREDERICK WALKER, C.E.	74
FOREIGN AËRONAUTICAL PERIODICALS	74
NOTABLE ARTICLES	75
APPLICATIONS FOR PATENTS	75

LONDON:

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

Digitized by Google

THE AËRONAUTICAL JOURNAL.

BACK NUMBERS.

In reply to numerous enquiries, back numbers of the AERONAUTICAL JOURNAL may be obtained from the Publishers, Messrs. KING, SELL AND OLDING, LTD., Lonsdale Chambers, Chancery Lane, London, W.C.

The following is a list of Articles of special interest which have appeared in the AERONAUTICAL JOURNAL :—

THE DEATH OF LILIENTHAL.—January, 1897.

FLYING MACHINES: Lecture by the late Mr. P. S. PILCHER.—April, 1897.

LANGLEY'S FLYING MACHINE (Illustrated).—July, 1897.

KITES: their Theory and Practice, by Major B. F. S. BADEN-POWELL.—April, 1898.

EXPERIMENTAL SOARING, by the late Professor G. F. FITZGERALD, F.R.S.

THE ZEPPELIN AIRSHIP (Illustrated), by Major B. F. S. BADEN-POWELL.—October, 1899.

FATAL ACCIDENT TO MR. PILCHER (Illustrated).—October, 1899.

THE BALLOON AT THE FRONT.—January, 1900.

ON FORMS OF SURFACES IMPELLED THROUGH THE Air, and their Effects in Sustaining Weights (with Diagrams), by F. H. WENHAM, C.E.

THE ZEPPELIN AIRSHIP, by Sir HIRAM S. MAXIM.—October, 1900.

PORTABLE ELECTRIC BALLOON SIGNALLING IN War, by ERIC STUART BRUCE.—October, 1900.

Special Illustrated

Paris International Aeronautical Congress Number,

. . . . January, 1901.

CONTAINING AMONGST OTHER ARTICLES:—

THE PRESIDENTIAL SPEECH.

THE SECTIONAL SUBJECTS AT THE PARIS CONGRESS.

M. SANTOS DUMONT'S NAVIGABLE BALLOON, by a Member of the Paris Aéro-Club (Illustrated).

THE VINCENNES COMPETITIONS, by HELEN AUXILIUM BRUCE (Illustrated).

SOME CELEBRITIES OF THE PARIS CONGRESS:

1. M. JANSSEN (Portrait).
2. MAJOR F. C. TROLLOPE (Frontispiece).
3. M. WILFRED DE FONVIELLE (Portrait).
4. M. JACQUES FAURE.
5. M. LOUIS TRIBOULET (Portrait).

THE AËRONAUTICAL JOURNAL.

OCTOBER, 1902.

The Aeronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

53, Victoria Street,
Westminster, London, S.W.

NOTICES

OF

The Aëronautical Society.

At a meeting of the Aëronautical Society held at the Society of Arts, John Street, Adelphi, the following gentlemen were elected members of the Society:—

DR. WILLIAM NAPIER SHAW, F.R.S.

MR. FREDERICK JOHN MELVILLE.

The following gentleman was elected a member of the Council:—

DR. WILLIAM NAPIER SHAW, F.R.S.

On Monday, July 21st, when Major B. F. S. Baden-Powell arrived at the Victoria Barracks, Windsor, in command of the time-expired men and reservists of the Scots Guards, he was met by a deputation from the Council of the Aëronautical Society of Great Britain, who presented him with an illuminated address as follows:—

To MAJOR B. F. S. BADEN-POWELL, Scots Guards, President of the Aëronautical Society of Great Britain.

We, the undersigned, members of the Council of the Aëronautical Society of Great Britain, offer to you our sincere congratulations on your safe return from the war in South Africa, and, as we trust, in the best of health.

It is a source of much gratification to us to know that in your absence from our Council you have carried out such useful and successful experiments with your military kites.

It is with very great pleasure that we welcome you home.

(Signed),

EDWIN ARNOLD.
EDWARD BARRY.
CRAWFORD.
LESLIE M. EARLE.
EDWARD P. FROST.
JAMES GLAISHER.
HIRAM S. MAXIM.
H. C. ROBERTS.
CHARLES WARREN.
ERIC STUART BRUCE,
Honorary Secretary.

Digitized by Google

The opening meeting of the new session of the Aëronautical Society of Great Britain will be held at the Society of Arts, John Street, Adelphi, early in December, when Major B. F. S. Baden-Powell, Scots Guards, the President of the Society, will take the chair, and deliver an address on "Recent Aëronautical Progress."

There will also be papers on :—

"The Contributions of Balloon Investigations to Meteorology," by Dr. William Napier Shaw, F.R.S., and "The Kite Equipment of the Scottish National Antarctic Expedition," by Mr. John Anderson (with Lantern Illustrations).

Due notice will be given of the exact date of this meeting.

INTERNATIONAL KITE COMPETITION.

There will be an International Competition for the Highest Kite Flight under the auspices of the Aëronautical Society of Great Britain next year. The award will be the silver medal of the Society. Full particulars will be announced in the January number of this Journal.

CHANGE OF ADDRESS OF THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN.

Members of the Aëronautical Society of Great Britain and others are reminded that the new address of the Society is

53, Victoria Street,
Westminster,
London, S.W.,

where will be the Office and Library of the Society. All communications should be addressed to the Honorary Secretary at that address.

After the Library has been duly catalogued and put into order at the new premises, arrangements will be made for it to be open to members on stated days for reference, due notice of which will be given.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

The concluding meeting of the Session of the Aëronautical Society of Great Britain was held at the Society of Arts, John Street, Adelphi, on Thursday, July 17th. Mr. E. P. Frost, J.P., was in the chair.

On the platform was the Brazilian Minister accompanied by the whole staff of the Brazilian Legation.

The Chairman: Ladies and Gentlemen,—I am sure we are all very pleased to hear such gratifying reports of our King, and delighted to hear that our President, Major Baden-Powell, is expected home very shortly; and I need, at the present moment, only call upon the Honorary Secretary to read the minutes.

The Honorary Secretary read the minutes, and announced the receipt of several messages, telegrams, and letters of regret from those unable to attend the meeting. Amongst these names were Lieut.-General Sir Charles Warren, Sir William Crookes, Sir Hiram S. Maxim, Major H. C. Roberts, Lieut.-Colonel Templer.

The Chairman, in calling upon the Honorary Secretary to read the first paper, announced that the Brazilian Minister had honoured the meeting with his presence that evening. (Applause.)

He remarked that the paper on "The Peace Balloon of the late Senhor Augusto Severo," by Dr. Carlos Sampaio, had been put into the hands of the Honorary Secretary by the Brazilian Minister only a few days before the fatal accident to Senhor Augusto Severo.

The "Peace" Balloon of the late Senhor Augusto Severo.

I.—By DR. CARLOS SAMPAIO.

The conquest of the air, by solving the problem of the direction of balloons, is the subject of the present day; and its solution will be the indispensable complement of the problem of mechanical locomotion.

If, in the 20th century, the problem of mechanical locomotion was solved in the most simple case, that of linear locomotion, or at one dimension, constituted by all the means of transport in railways of whatever nature, where, whether by steam or by electricity, velocities over 100 kilometres per hour were attained; if, also, astonishing results were obtained in the case of plane locomotion or at two dimensions, whether terrestrial, by means of automobiles which have already developed velocities of over 60 kilometers per hour, or

maritime by means of large steamers having velocities of over 20 knots per hour; the 20th century seems to reserve us the surprise of furnishing the solution of the more difficult case—that of locomotion in space or at three dimensions, whether maritime, by means of submarines, which, when submerged, have a velocity of eight knots per hour, or aerial, by means of balloons, which, by the experiments of Santos Dumont, can have a velocity of 8m. 50 per second, *i.e.*, 30.600m per hour.

As may be seen, however, the final result in the last point is not yet obtained, as great velocity is required to oppose the wind, whose



THE LATE SENHOR SEVERO.

force, often enough, is equal to 15m. per second, or 54km. per hour.

We do not know what velocity will be reached by the system of which we are now to treat, but we are far from believing that a speed of 25 metres per second, which we are promised by its author, will be attained. Whatever the defects and inconveniences, however, of this system, the inventor proposes to himself the realisation of two ideas, which, by themselves, form an important progress in aërial navigation.

These ideas for which we have contended in various articles, we have written on the subject, are of vital interest for the solution of the problem.

(a.) The coincidence of the centres of traction and resistance, not only to avoid wavering, in order to annul the perturbing couple, but also to use in a better way the motor's force which is *all* employed in producing the propulsion, instead of being *partly* distracted to produce rotation.

(b.) To form but one body of balloon and boat, so as to propel only one single system, instead of two joined by flexible intermediaries, which was the case in balloons hitherto constructed.

In his romance, "Five Weeks in a Balloon," Jules Verne already said (page 58), "It would be necessary to discover a motor of an extraordinary power, and of an impossible lightness. And yet we shall not be able to resist winds of any importance. Hitherto people have occupied themselves rather in *directing the car than the balloon*. This is a mistake."

An invention, however, is characterised not by the idea, but by its realisation, and without doubt the idea of placing the propeller in the body of the balloon already presented by several authors (Farcot in 1859, Smitter in 1866, Micciolo Picasse in 1871, Cordenous in 1875, Capt. Danrit in "War in Balloon"), as well as that of building balloon and boat in one single system, suggested by us in 1895, are for the first time, really put in practice by Senhor Augusto Severo. It is not easy to give a description of this system, which is quite original, and completely different from all until now constructed, but we may be allowed to present a conception easily to be conceived by those who never saw it.

Let us imagine a melon from whose lower part a slice has been cut out (a solid of revolution with the spindle extracted), and we have the exact form of the envelope intended to contain the hydrogen which produces the ascensional force.

The slice is substituted by a boat made of bamboo, and ending into a dihedral angle in its upper part, so that the apex of the angle coincides with the largest axis of the balloon, which is the axis of rotation of two propelling screws placed at the stern and prow respectively. The driving force is furnished by two petroleum engines (Buchet system) of 16 and 24 horse powers. The propeller at the stern is six meters of diameter, and that of the prow of a smaller one, four meters, the latter having the form of two wings whose purpose is to suck in the air, and so diminish the pressure on the walls of the balloon.

Besides these, we find a propeller *in* the boat, really a compensating screw, for maintaining the airship in an horizontal position.

Digitized by Google

or to determine better the coincidence of the centres of propulsion.

In substitution to a rudder the author places two transversal propellers beneath the balloon's longitudinal axis at the two ends of the boat; when acting, either separately, or combined in opposite directions, they cause gyration of the system round a vertical axis which passes throuh the centre of mass; but when working simultaneously in the same direction, they are supposed to impede the lowering of the balloon, which may be produced by a lateral wind. The envelope of the balloon is 30 meters long, and 12 ins. diameter, holding 2,000 cubic meters of gas; it is of unsymmetrical form, broader at the prow than at the poop; and has at each side of the boat two compensating ballonets as generally used in dirigible airships.

The motor's engines are protected by a metallic cover. Davy's lamp system is here, for the first time, employed in aerial navigation.

It is as easy to recognise the absurdity of certain ideas about aërial navigation, as it is difficult to foresee the results of a new rational system of airshipping, aërial locomotion being a science that has not yet the complete sanction of practice. It is, using the theories until now established, supported by mechanical laws, that we shall venture to enumerate the qualities we consider defects in the present system.

First, the boat, which otherwise forms a notable originality is too heavy, the inventor having overlooked the essential quality in aërial navigation, that of extreme lightness. Also as regards resistance, much is to be desired, principally in relation to the flexibility.

Second, the diameter of the balloon (12 metres), is excessive, and the formula $T = K.A.V.3$, where T. represents the work, K., a practical co-efficient equal to .025, but whose exact value is still to be determined, A., principal section of the balloon, and V. its velocity, shows that Senhor Severo, though his balloon is fitted with two engines, will never be able to attain a velocity superior to 11 meters per second; but even this would be a very good result.

In the third place, we fear that the employment of two propelling screws are rather at a disadvantage, similar to the action of two railway engines, placed at the two ends of a same train. We observe, by the way, that the diameter of the propellers is unproportional to the diameter of the airship.

What most, however, preoccupies our mind, is the complete absence of resistance to flexibility which presents the edge of the boat's framework, from the longitudinal axis of the balloon. Given the case that, as generally happens, the wind is blowing in gusts, and, therefore, constantly changing the magnitude of its force; it is very probable that, in this event the framework could never resist to the bending force produced, especially when, besides this, by the action of lateral screws, the balloon should oppose the wind on the side.

Finally, we consider the omission of the rudder a mistake, because it has always the most effective way of directing submerged bodies in fluids. The chief object is not to oblige the airship to make large revolutions, but to bring it back into its original direction, when deviated by accidental causes. Our opinion is that we must obtain the least superficie with the greatest sensibility, for which the rudder should be placed at the poop of the balloon, behind the propeller screw, in order to take advantage both of the natural air-current, caused by the displacement of the balloon, and of the artificial current, produced by repulsion due to the propellers' motion.

We think, therefore, that the substitution of the rudders by the two transversal propellers is an unhappy one, particularly when their axes are placed considerably below the balloon's longitudinal axis. It is difficult to understand that Senhor Augusto Severo, who makes so great a question of the coincidence of the centre of traction with that of propulsion, should have forgotten that it is necessary to consider the same condition when treating with lateral displacements, whether to prevent pitching, or to revolve the system on itself; for the very same reason that the propelling screws should be placed so that the direction of propulsion should pass through the centre of resistance, the directing screws should have their axes on the horizontal plane of the balloon passing through the centre of lateral resistance.

It being generally accepted that the whole motive force should be employed in the propulsion, why, then, distract a part to obtain direction? Notwithstanding our different conception of several details we have the greatest desire to see Senhor Severo's efforts crowned with success. Whatever might be the results of his experiments, he is the first to have adopted a system in which balloon and boat form one single body, and in which the propulsion is effected in the most convenient place; this is enough to ensure Senhor Severo

Digitized by Google

a brilliant place in the history of aërial navigation.

II.—By ERIC STUART BRUCE, M.A.

The Greek Philosopher Aristotle, in no portion of his great ethical treatise showed more conclusively his profound knowledge of human nature than in those sentences by which he describes the difficulty of man in preserving the mean. If the balloon "La Paix" had successfully accomplished its projected course of 18,000 metres from the Parc D'Aërostation at Vangirard, to the Champs De Manœuvres at D'Issy, the world would have resoundel with the praises of Senhor Augusto Severo, and the wave of popular enthusiasm set in motion by the aërial feat of M. Santos Dumont would have been redoubled in its force. But in aërial experiments it is often a hair's-breadth which separates success and failure, life and death. In the martyrdom of Senhor Augusto Severo and M. Georges Sachet for the cause of science, once again the attention of the world has been drawn to the dangers braved by those who attempt the mastery of the air, once again has a depression fell upon aëronautical enterprise, once again the sceptic shakes his head and says, to what purpose is this waste of human life?

But Science does not measure progress by the deceptive scale of a momentary success or failure. It regards both from the only safe point of view—the Aristotelian mean.

It seems, therefore, fit, that on the occasion of the universal consternation, that the destruction of "La Paix" has aroused, a Society which devotes itself to the scientific consideration of aërial topics should point out that if Senhor Severo failed in his attempt there was, at any rate, one vital point in his system which cannot be obscured even by the intense horrors of the disaster, and is destined to arise from the ashes of the ill-fated aircraft.

It is now for others to seek to apply that vital point in a way that will not be dangerous. That point to which I refer is the one already emphasised in Dr. Carlos Sampaio's paper, which has just been read to you, viz., the combination of balloon and car in one symmetrical body, so that the propeller may be placed in the position to propel the whole system.

Such a system, however, necessitates the adoption of a very small space between the car and the balloon proper, and for this reason the presence of petroleum motors in the car cannot fail to be dangerous. The proximity of the motors to the borderland of the great mass of gas, the distance being not above a metre, was, indeed, the cause of the fiery end of Senhor Severo's balloon. For it is the borderland which is the place of danger where there are oxygen atoms to combine with the hydrogen atoms. I take this inverted jar of hydrogen and plunge a lighted taper into it. The hydrogen takes fire at the mouth of the jar, but the taper goes out when I thrust it upwards into the jar. (Experiment shown.) Hydrogen gas takes fire under certain conditions, but is incapable, of itself, supporting combustion. The flame you have just seen burning at the mouth of the jar is the effect of the great affinity which exists between the atoms of hydrogen and the atoms of oxygen, which latter, in the atmosphere of this room border upon the hydrogen of the jar. Further up in the jar the hydrogen atoms have no oxygen atoms wherewith to combine. The presence of flame or electric sparks on a balloon near the borderland, where there may be an escape of hydrogen either through automatic valves, or even through the material of which the balloon is made, must be an element of danger. I fill this soap bubble with gas, and when it is rising apply a flame to the dangerous borderland. There is a conflagration of the miniature balloon. (Experiment shown.) I cause electric sparks to come in contact with the soap film and we have another conflagration. (Experiment shown.) These simple experiments emphasise the danger of the borderland. It is a fact not, perhaps, generally appreciated, that a little beyond the dangerous borderland inside a balloon where there are no oxygen atoms we might leave a red-hot poker with impunity. Here I have a glass globe through which a continuous stream of coal-gas is passing. You see this must be so for I have ignited the gas jet coming from this globe. I have stretched a little piece of platinum wire across the terminals of an electric battery and placed these terminals inside the globe. Now I will cause the electric current to pass through the piece of wire and it becomes red hot with impunity. (Experiment shown.) Again, though an electric spark at the borderland is a source of danger, it can exist harmlessly when the borderland is passed. Here I have a naked electric discharge sparking away harmlessly in the centre of another globe filled with coal-gas. Senhor Severo had intended to apply the Davy lamp principle to his balloon, and surrounded his motor with wire gauze, but from some reason this precaution was omitted. It is, however, likely that the application of

Digitized by Google

the Davy lamp principle to a navigable balloon would be fallacious, as it is well-known that the Davy lamp principle does not act under pressure. Such pressure, however, would be often afforded in the case of a navigable balloon by the air current.

As it is clear that it is dangerous to employ petroleum motors in close proximity to the balloon, it is also clear that if the grand idea of propelling balloon and car in one body is to survive its inventor other safer means of deriving motive power for the screws will have to be adopted. It would seem that for such a combination there is, according to present knowledge, only one safe means of obtaining power—that is electricity.

It will at once be urged that, with electricity, it is impossible to obtain sufficient power for the screw owing to the weight of the battery, whether primary or secondary. To this I would reply, supply is regulated by demand. Let aëronauts demand from electricians a sufficiently light and portable battery to provide power to combat light winds, and the supply will be forthcoming.

It must be remembered that in 1885 Captains Krebs and Renard experimented with their navigable balloon "La France" in which the motive power was derived from electricity, and navigated their balloon against a wind of 3½ metres a second.

Since that time batteries have improved in both efficiency and portability. At that time such an excellent device as the ever ready dry battery by which we can obtain an electric light at will would have been thought an impossibility.

It was Sir Hiram Maxim who, when devising his celebrated aëroplane flying machine, first set the example of making a steam boiler of extraordinary lightness for the power developed.

In the words of our President, Major Baden-Powell, "No one, before this was constructed, could have believed in the practicability of making a steam engine of 300-horse power and placing it in a flying machine presenting some thousands of square feet of surface to the air, the whole apparatus only weighing some three tons." Let some chemist or electrician turn his whole attention for a while to produce an electric battery which will be like the steam engine of Sir Hiram Maxim, a miracle of lightness and efficiency, and he will have given a large impetus to aëronautical science and transformed the dreams of the lamented Brazilian aëronaut into a possibility.

Bearing in mind the experiments I have shown you, emphasising the possibility of red hot wire and naked electric sparks in the interior of a gas balloon, perhaps, in the future, that spot may be chosen for the position of the batteries and motors in airships.

In showing on the screen the portrait of Augusto Severo, I will say just a few words about the personality of the illustrious Brazilian who, with his engineer, perished on May 11th, in the cause of Science and Cosmopolitanism.

Augusto Severo, who was a member of the Brazilian Parliament, was a man of many sides and of brilliant achievements. He was distinguished in Science and renowned as an orator. He was a philanthropist in the widest acceptance of the word, for the passion of his life was to do all in his power to promote the cause of International peace. It was this object which enkindled his enthusiasm for aëronautics, and to progress in that science he looked as the surest means of realising the dream of the idealist. This noble passion no doubt led him to plead with brilliant eloquence the cause of aëronautics in the Brazilian Chamber of Deputies, on June 17th, 1901, when the Chamber was for eight days transformed into a National Aëronautical Congress. It was his convincing eloquence that won for the hero of the Eiffel Tower national recognition, and a vote of 125,000 francs for the experiment of the 13th July, 1901. By this enlightened act Brazil placed herself in the van of progress amongst the nations, and in thus being the first nation boldly to proclaim that aëronautics can no longer be regarded as a mere pastime but as a noble science, destined to enlarge the boundaries of many other sciences and to advance the progress of man, Brazil will have won the reverence and esteem of aëronauts of every nationality for all time. (Applause.)

VOTE OF CONDOLENCE.

The CHAIRMAN: As there is no discussion upon these papers that we have heard read in the absence of our friend Major Roberts (who should have taken the chair this evening, and I am sorry to say is prevented from doing so by illness), I think that this period of the closing meeting of the session of the British Aëronautical Society is a fitting opportunity for making a few remarks upon the lamentable accident to one who had achieved so much towards the solution of the difficult problem

Digitized by Google

of aërial navigation; and while we welcome amongst us this evening our distinguished visitor the Brazilian Minister, and others who have honoured us with their presence, I am quite sure that we all wish to express our deepest regret at the sad catastrophe which happened to Senhor Severo, and to offer our sincere sympathy to the Brazilian nation in the sad loss of a brilliant politician as well as an intrepid and enterprising aëronaut—a man that the world could ill afford to lose. I will, therefore move a vote of condolence with the Brazilian nation, a nation so illustrious in aëronautical achievements.

Major F. C. Trollope (late Grenadier Guards): Ladies, your Excellency, and Gentlemen,—I am honoured by the wish that has been expressed that I should second this vote of condolence to the Brazilian nation. The Brazilian nation has shown us the way in the aëronautical world by producing such men as Santos Dumont and Augusto Severo. Unfortunately, this deplorable accident has taken place, and has put us back a little; but still, we hope to try again. I beg to second this deep vote of condolence from the whole of the British Aëronautical Society.

Dr. Hugh Robert Mill, LL.D., F.R.G.S. (Secretary Royal Meteorological Society): Mr. Chairman, I am honoured to be asked, as a representative of British Meteorologists, to support this vote of condolence with the Brazilian people. I may, perhaps, be allowed to say one word as to how it is that meteorologists look with such hope and such interest at the advances in the navigation of the air. It has gradually been dawning upon the meteorological world that the great problems which effect the distribution of the weather on the surface of the earth will only find their solution when the movements of the upper air have been fully investigated and understood. Now, we have done for many years past, what has been possible, and done it with difficulty, in the way of starting high level observatories. We have also, following in this case the lead of the United States of America, endeavoured, by the use of kites, to carry our meteorological instruments up to a great height in the free air. And for a very long time back, in fact ever since balloons were first introduced in this country, meteorologists have taken a leading part in the investigations of the higher air. But the great desideratum is to have the means of moving freely up and down and to and fro; to have the means of staying aloft for as great a time as may be required, stationary, or moving as desired in any direction; and it is there that we look to Brazil for great developments in the future. The illustrious Brazilians, whose work in proving practicable—proving, at least, possible—the navigation of the air, have, it seems to me, laid the whole world deeply in debt. And no one—no people—are more ready to appreciate valour and enterprise than we of the United Kingdom. I remember very well how, when Dr. Nansen started forth on an enterprise which, to geographers, appeared quite as dangerous and quite as uncertain as aërial navigation may appear to ordinary engineers, that he resisted all arguments proving the danger of the enterprise. He had convinced himself of the truth of his theory, and he was prepared to risk his life on that fact. And when he returned with a quiet modesty, he simply said that he had proved his theory to be true. Now the line, as Mr. Bruce so very truly said, between success and failure in all new enterprises is a very narrow line indeed. And it is hardly within human control to say on which side of the line any given experiment will terminate. But I think the spirit of the old English poet animates us still when we consider that "He either fears his fate too much or his desert is small, who will not put it to the touch and win or lose it all." And in memory of one who did put it to the touch, and happened to lose it all, I think that we ought to associate ourselves in this vote of condolence with the Brazilian people, that great nation of the South-West upon whose flag there appears the brilliant motto incorporating order with progress. (Applause.)

The Chairman put the vote of condolence to the meeting, and it was carried unanimously.

The Brazilian Minister: It is deeply touching to Brazil, I can assure you, to receive the sympathy from the Aëronautical Society of Great Britain on the fate of our lamented countryman, Senhor Augusto Severo. We live in such a crowded time that one cannot feel to their full extent the shocks that come every day upon us from all parts of the world, as, by their number and their diversity, they almost at once destroy and replace each other. The catastrophe which befell the Brazilian aëronaut was, in that way, overshadowed by another, the much greater one, that made of Saint Pierre, a new Pompeii. But for that rapid succession of discharges from the daily apparatus in constant operation upon our curiosity, our concern, our interests in all things human, the Paris fall would have remained longer present to the

Digitized by Google

world, as it really grouped some of the characteristics of the tragic side of glory. Senhor Severo, like other Brazilians, had been before carried away by the balloon enthusiasm, but politics made him for a time lose trace of his fixed intent, when the Santos-Dumont tour of the Eiffel Tower came to awake his life's, or his death's, call. It was not jealousy, nor spite; it may have been competition, or emulation, but even that, by pure casualty or coincidence; it was another thing, it was the natural prompting, the inborn inspiration, set in motion by patriotic ambition. He was our second comer, and he thought he would increase, ten times, the natural asset created by Santos Dumont. I regret I am incompetent to deal with any of the scientific or practical merits of his balloon. There is only one point with regard to him upon which I can touch, and that is the noble sacrifice he offered, in his country's name, to the cause of Science. That sacrifice, whether you call it success or failure, we trust, will not remain sterile. Science advances mostly by the faith, the perseverance, the effort, the devotion of the common worker. The achievement, the invention, the stroke of genius or of luck, that form the visible personal contributions, are like everything else, the effect of the pressure from the circumference, the work of the same organic force that, at the proper time, shapes, hardens and ripens the results, like the fruits on the tree. One cannot make too much of imagination, which, alone, no doubt, possesses the creative touch; but one must make still more of the spirit of devotion and sacrifice, whence the kindling spark will ever come of the generosity that links together in the same chain the man who fails and the man who succeeds. The solidarity of success and failure, of finding and searching, of invention and routine, of steering and straying, of victory and disaster, is in the history of Science the necessary qualification of legitimate glory. It would be a sad day for Science when failure of a certain kind was not reckoned as secondary only to success. Ballooning, even now, seems among human achievements the one in which progress depends more on ever successive failures, if heroism and all its moral equipment can ever be called failure. We cannot as yet think of aëronautics as a science that could have been worked out to perfection at the proper time by the simple progress of mechanics, and without one single life being risked. But if such is to be the concept of the future, that would not render the disasters of the pre-scientific times less honourable, and, perhaps, their legend would even grow, once closed the long martyrology of the air. The names written in it for the sake of progress and of Science, as well as of human ambition, like Andrée's or Severo's, will endure for ever. I honour our illustrious countryman's courage, his devotion, his thoroughness of purpose, his loftiness of ambition, his patriotic duel in the heights of the air with Santos Dumont, but above all I honour his fate. Men of that stamp will always be the pride of mankind, if, for nothing else, for their daring and for the kind of game at which they stake their lives. This is a sport of immortality. Last year the aëronauts of England honoured immortal success in Santos Dumont, to-day they honour immortal failure in Severo. It is because they know that, chiefly in their own career, in their deadly flight, failure and success are parts, fragments of each other, successive stages of the same successful evolution. I thank the Aëronautical Society for this demonstration. It is very flattering also, for us, that it met to-night to hear and to applaud a paper on Severo's invention by another Brazilian, Senhor Sampaio, a man of great mechanical and mathematical faculties. I am glad to hear from such authorities as we listened to to-night that the system deserves another test and that it will bear improvement. Senhor Severo's funeral in Rio de Janeiro, you will be gratified to hear, was of unprecedented national magnitude. That means we will remain attached as a nation to the great problem for which he laid down his life. Allow me to pay a finishing tribute of respect to his fate-companion, Monsieur Sachet, for his fearlessness and his disinterestedness, qualities that are inseparable from your noble calling, whatever its rank, but in no one so admirable as in those who have nothing to expect from glory. (Loud applause.)

Balloon Ascents in Thunderstorms,

By The REV. JOHN M. BACON.

Several authentic instances are on record of a balloon either approaching the neighbourhood where a thunderstorm is in progress, or of becoming actually enveloped in an active thunder pack. It is, however, to be regretted that these exceptional experiences have for the most part occurred to voyagers who, not being trained observers, have failed to furnish information of much practical or scientific value. All too obviously, for the most part accounts

have been overdrawn, an error to be extremely regretted both in the commercial as also in the scientific world. It is generally difficult to form a true picture or estimate of the phenomena recorded, and, perhaps, it would not be unjust to urge that all newspaper reports should be strictly estimated at their value as such.

A correspondent in the *English Mechanic* quoting from the *Canadian Weather Guide*, states that the aëronaut, S. A. King, ascended in August weather from Burlington, Iowa, just as a thunderstorm was approaching. When, in the moment of leaving the ground, his balloon was rapidly carried towards the thunderstorm, through which he was borne upwards. But instead of his piercing through the upper limits of the storm "there came down right in front of him, and apparently not more than 50 feet distant, a grand discharge of electricity." Then he felt the car lifted as the balloon was hurled through the cloud, and though it is not quite clear where he was hurled to, it is stated that fresh discharges of electricity kept doing the same thing over again till, finally—the most intelligible part of the narrative—heavy rain carried him down.

Again, the same correspondent, quoting from records, tells of M. le Moste ascending from Dunkirk on June 9, 1883, and being carried into a storm-cloud, where the "beating of the rain, the heavy gusts of wind, and the loud reverberations of the thunder, put the stability of the balloon to a fearful test." Here it would almost seem that the loudness of the thunder was thought to endanger the balloon.

But there follow equally extraordinary statements affecting a French aëronaut of European fame, M. Eugene Godard. Three journalists were his companions in an ascent during which "the balloon was caught in the middle of a thunderstorm, and twice the lightning flashed within a few yards of the terror-stricken crew." Surely it is the journalists here who are responsible for the statement!

Yet another quotation is given, and one which we may regard as of another order. It relates to a public ascent made at Frankfort-on-the-Maine by Green, junior, on August 22, 1847. The hour of departure was 5 p.m., and it appears that Green was determined to keep faith with the public, notwithstanding the fact that a thunderstorm was blowing up with a hurricane of wind from the south-west. When at about 4,500 feet elevation and level with the storm-cloud, the rain was descending like a waterfall. Each discharge of lightning caused a vibratory motion in the balloon. In this instance the aëronaut succeeded in ascending above the storm, when a fine breeze from the north-west carried him clear of the disturbance.

It will be interesting to take the above narration in connection with a report on thunderstorms due to two eminent amateur astronomers, Prebendary Webb and Rev. T. E. Espin—the result of many years' research. According to these observers, when the thunderstorm is coming on the wind is usually blowing N.E., "or against the direction that the storm is coming from." Thunderstorms "come almost invariably from the south-west, and as soon as the storm has passed the wind will blow after it."

But quite as valuable a record is afforded by Charles Green, senior, in an ascent from Newbury in 1827. Green, describing the occasion himself, relates that the morning was very squally, and that the balloon could scarcely be kept down even with the strength of a hundred men. The force of the wind never abated, and when, at 6 p.m., the balloon was released, "it bounded off with great velocity in a S.E. direction, and in a very short space of time was riding the gale at a height of two miles. At this altitude we perceived two immense bodies of cloud operated on by contrary currents of air, until at length they became united, and at that moment my ears were assailed by the most awful and long-continued peal of thunder I ever heard. These clouds were a full mile beneath us, but perceiving other strata floating at the same elevation in which we were sailing, which, from their appearance I judged to be highly charged with electricity, I considered it prudent to discharge twenty pounds of ballast, and we rose half a mile above our former elevation, where I considered we were perfectly safe and beyond their influence. I observed, amongst other phenomena, that at every discharge of thunder all the detached pillars of cloud within the distance of a mile round became attracted and appeared to concentrate their force towards the first body of cloud alluded to, leaving the atmosphere clear and calm beneath and around us."

Charles Green's American contemporary, John Wise, describes a similar appearance of the storm-cloud as viewed from above. He compares it to a violent ebullition which soon developed itself into uprising cloud columns discharging flashes.

Very similar, again, is a description of Captains Peytier and Hossard in 1825; who, from the Peak D'Anie, in the Pyrennees, made

Digitized by Google

several observations of thunderstorms when these were in progress below, so that the upper surfaces were well seen. These surfaces were always noticed to be broken into ridges and protuberances, rising to great heights, like Alpine peaks.

But no more instructive instance of a thunderstorm observed from above is to be found than that reported last year in the Journal of our Society. I refer to the occasion when three lieutenants of the Prussian Balloon Corps made an ascent from Berlin on June 5, 1900. In this case the balloon was moving from the south-west at a height of 2,300 feet, when it became enveloped in a thunder-cloud. Sharp crackling sounds, as also loud hissings, were heard, accompanied by sparks, one of which was estimated as twenty-seven inches long.

Commenting on this storm, Dr. R. H. Scott points out that, though the thunderstorm at the time passed over Westphalia to the westward and over Pomerania to the eastward, yet no storm was experienced at Berlin underneath. And his explanation is that over the Valley of the Spree, the water being cooler than the air, there was a descending current of air which counteracted the normal ascending current of the squall, the consequence being that the thunderstorm was kept up and so jumped over the river. Dr. Scott adds, "the barometer at Berlin at the time showed the ordinary little jumps characteristic of the passage of thunderstorms, but no thunder or lightning was noticed in the city."

The following is an occasion when, during a balloon voyage from Newbury, I was unexpectedly enveloped in a severe thunderstorm, and remained for some time a close observer of the phenomenon. The date was July 27, 1900, a day which, opening with fair promise, became characterised shortly after noon by a succession of heavy electric storms, increasing in intensity and duration as the day wore on. Wind vanes remained pointing eastward, while cloud, at the height of some 2,000 feet, sailed away from the west. At less than this height, however, pilot balloons which started towards the west became headed back. The ascent was made at 5.15 p.m., at which time the clouds had all dispersed and the wind had lulled. Our course, which at first lay to the north and the north-west, turned nearly due west, and followed pretty closely the windings of the Kennet Valley.

It was about twenty minutes after the start that the air below us, and yet more ahead of us, began rapidly growing murky, while our rate of progress became greatly accelerated. At this period no well-defined clouds were noticeable, our environment being veiled by the curtain of grey haze around; but from the starting ground at Newbury a vast thunder-pack was seen to be already upon us. Then the storm broke with a blinding sheet of hail, and a downrush of piercingly-cold air, the prelude to a terrific display of lightning, which flashed with great frequency and on all sides of us. Observers below informed us that we appeared to be embosomed in the heart of the storm, which completely enveloped us.

To ourselves, though the view overhead was hidden by the vast bulk of the balloon, it was evident that the flashes emanated from a region somewhat above our own level. Thus, to the eye, the manifestations of the lightning partook of the usual appearance, namely forked streaks of flame; but so bewilderingly brief and brilliant that the mind could scarcely determine whence they came or where they vanished. The thunder was no less remarkable, being short, with little rolling. It was clear that existing conditions stifled to us the usual reverberation; and this fact was confirmed by an experiment. Just as the storm was gathering I had fired a gun-cotton fog-signal below the car, and had remarked how the long-rolling echoes, always evoked, had been almost entirely quenched. Doubtless, then, the air was in extreme turmoil, either the cause or consequence of the electrical disturbance then being manifested. Broadly, the atmospheric conditions at this moment were a lower warm and now fast current still setting westward, an upper current bearing the storm-cloud diametrically opposed to the former, and, again, a swift, overmastering down-draught of ice-cold air, sweeping down the hail and carrying us towards earth.

A question arises here of much interest to aëronauts. Is a balloon entrapped in a thunderstorm in special danger of being struck by lightning? My own belief is that if it is being held captive by a steel cable the danger is extreme; and we heard of a fatal accident not long since to soldiers in charge of a military balloon kept flying while thunder was round. On the other hand, I do not fancy that special danger from lightning attends a free balloon if only from the fact that I know of no record of disaster, though balloons must have constantly ascended in thundery weather.

A feather or other floating body in the neighbourhood of an electrical machine in action is surely repelled rather than attracted. There is, however, of course, always the

possibility of a floating balloon being in a line of low resistance in which a discharge is preparing, in which case it would surely encounter such discharge.

After the reading of this paper, Mr. Bacon exhibited several lantern slides illustrative of his remarks, including a very fine series of photographs of lightning flashes.

Note on a Performance of the "Bristol" War Balloon during the South African Campaign.

By CAPTAIN H. B. JONES, R.A.

[This communication formed part of a letter from Captain Jones, received from Machadodorp, Transvaal, by the Honorary Secretary.] It was read in the absence of Captain Jones by the Honorary Secretary.

"The 'Bristol' War Balloon, 11,500 cubic feet capacity, was first filled on March 6, 1900, the gas being transferred from 'Duchess of Connaught' leaking badly from bullet-holes received at Paardeberg. The balloon was up throughout the fight at Poplar Grove, and was emptied on March 9 without any repair in shops at the base; it remained on the section waggon until filled at Vet River (advance from Bloemfontein) on May 6. It was used at the engagements at Vet River and Land River, and arrived at Kroonstad on May 12. The balloon was kept in a sheltered place near the river till we marched again, on May 22, and was not emptied till after we had crossed into the Transvaal at Vereeniging on May 27. To keep a balloon going for 13 days at one station is a good test, but in our case the 'Bristol' was filled for 22 days, and did a march of 165 miles with the division.* It is unnecessary to say that this could not have been done with even a perfect balloon unless the weather had been good and the men of the section highly trained; it speaks wonderfully well for the fabric. The leakage was practically nil, but we occasionally had to run in some gas in the early morning to prevent the risk of towing a *ballon flasque* against the breeze which always came up with the sun, and later in the day we had to allow the expansion to run out. We had a very hard day the day before we crossed the Vaal, and I was inclined to empty the balloon, but the whole section were keen to get the 'Bristol' into Transvaal territory, and we did so. Our transport was oxen, slow but sure. We generally got into camp after dark, and yet the men, tired with a long march, were always keen on doing everything they could to safeguard the balloon from the dangerous morning draught which caught her when she was slack and flapping."

* It was at Fourteen Streams that a balloon worked continuously with one inflation during the late war.—Ed.

Note on The Cycala Flying Machine.

By DR. CHARLES ZIMMERMAN.

The ideal Flying Machine is the product of Nature, *i.e.*, the soaring-bird type. We have been endeavouring to construct a duplicate for nearly twenty years. We do not expect to realize our ideal, but we can approximate it and come nearer to it than if we had never tried. In our search for the secret of man-flight, at least half a dozen full-sized man-carrying machines have been built and experimented with, besides numerous models, each a different design, and like all other machines designed to navigate the air by other students and workers, failed to do more than get broken and smashed in pieces long before the testing was half completed. Enough, however, was gleaned to demonstrate that we were on the right track, and a little nearer the long sought-for goal. Still, we had not, as yet, discovered the key to the hidden truth, and it was necessary to do the same thing over again, making changes here and there, adding new improvements, until, at present, there is great encouragement to continue in the line of thought and experiment chosen, as it promises finally to produce what we are all looking for, and that, very soon.

The machine, "Cycala," now building, is about (35 ft.) thirty-five feet across tips of wings. The latter I propose to vibrate vertically, to get forward motion on the ground as well as in the air. I constructed a model of the same design as my machine. It was about eight feet across wing tips; during the past winter it was submitted to many trials, with the result that ultimate success is promised with a larger machine.

In all my trials with different models, I have concluded that it is a matter of getting the first start on the ground. The machine must lift itself from level ground; in order to do this, there must be primarily traction or propulsion *on the air*; the rest is, we surmise, comparatively easy. This, of course, presupposes that equilibrium and alighting or stopping are worked out. A bird jumps up and simultaneously flaps its wings at starting, and *begins to fly* when its forward speed is only a couple of miles an hour. Now, why should not a properly-constructed flying-

machine, adapted to the strength of a man, do the same?

A motor can be applied when needed, in which case two or three pounds in weight can be carried to every one square foot of sustaining surface, and by vibrating the whole supporting surface, less forward speed will be required to elevate, and more weight to a square foot can be carried. As to the how and why of all this, I propose to inform the members of this Society, after the necessary trials have been made, as there are several ways of applying power, and it is more than probable that alterations will have to be made. I can, however, assure any who may be interested that I have a mode of vibrating my thirty-five-foot machine, and herein probably lies the secret. If we can readily and easily vibrate the wings sufficient propulsion will be developed to produce flight, but I beg time until it is tested. If it goes, the problem of a one-man machine is solved; but if it shows a predilection for sticking to the ground as have all its predecessors, I shall try again.

The CHAIRMAN: Ladies and Gentlemen,—I think a great deal might be said upon these interesting papers that we have heard this evening; but I think I shall be best studying your comfort if I make no comment upon them beyond thanking those gentlemen who have contributed the papers, and our Honorary Secretary for so ably reading no less than four of them. With these few words I beg to conclude the meeting. There is a machine, I am told, on exhibition here to-night showing new steering apparatus for balloons by Mr. Harris. He will be pleased to explain it to anyone interested.

The meeting concluded with a vote of thanks to the Chairman.

THE PRESIDENT OF THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN.

As will be seen in another part of this journal, the members of the Aëronautical Society will shortly have the long-awaited opportunity of welcoming their President. Readers of this journal have already been reminded of the long service of the President in the South African war with the Scots Guards, a service extending throughout the whole of the campaign. A daily contemporary has reminded the public that this period of active service is the longest the Guards have yet known, and that forgetfulness through lapse of time should not be allowed to be the cause of a welcome home that is not commensurate with the warmth of the farewell bestowed on regiment after regiment, when, on the way to South Africa, they marched out of barracks on the cold foggy morning in October, 1899.

But it is not necessary to give any such reminder to the members of a scientific society, for the students of science are daily trained to bind together in their minds the past and the present; and with the welcome which will be awarded Major Baden-Powell, when he first



MAJOR B. BADEN-POWELL,
President of the Aëronautical Society of Great Britain.

By permission of the Editor of "The Graphic."

takes the Presidential chair and addresses the Society on the progress that has been made in aëronautics since he left our midst to face the dangers of the battle-field, will be linked the vivid and grateful memory of the days during which he acted as Hon. Secretary to the Society. It is well known to our members that when Major Baden-Powell took up the Secretaryship of the Society on the death of the late Mr. Frederick Brearey, the Society, though not dead, was in a state of low vitality. But a few months of his energy aroused it into vigour. At the time he became the Honorary Secretary aëronautics was at low ebb throughout the world. Now, in every country, there are signs of daily progress. How much of the renaissance is due to those vigorous articles in the *Aëronautical Journal* from the pen of its

founder demanding the attention of the world for the science of the air?

It is hardly necessary to remind the members of the Society of the long connection of the President with aëronautical matters, but this journal now finds its way beyond the members of the Society to distant lands. Therefore, a few facts concerning our President's aëronautical career may be of interest.

It was in 1881 that Major Baden-Powell made his first balloon ascent in company with Mr. W. Powell, M.P., and Mr. Wright, the aëronaut. A little later in that year he ascended with Colonel Brine, R.E., and Mr. Simmons. In 1882 he joined the Scots Guards. In March, 1883, he made captive balloon ascents at the Brighton Volunteer review, and in the same year delivered a lecture on military ballooning before the members of the Royal United Service Institution. At this time he was much engaged in experimenting with model aëroplanes and aërial screw-propellers. In 1884, he bought the balloon Eclipse, and made several ascents in it at Aldershot. During 1884, Major Baden-Powell was in Egypt with the Camel Corps. In 1887 he began his experiments with kites. During 1888-91 he was absent on staff in Australia. In the autumn of 1892 he began those systematic experiments with kites, which were continued up to 1897. In the spring of 1894 he constructed the huge kite, 36 feet high, and made many trials with it at Pirbright. On June 27 in that year he first lifted a man from the ground by its means. In the autumn of the same year he went through a course of military ballooning at Aldershot. In September, 1895, he was able to lift a man one hundred feet by means of his kites, and gave a demonstration of the man-lifting power of his kites before the meeting of the British Association at Ipswich. At the present time, when the kite is rapidly coming into favour with meteorologists as one of the surest means of obtaining reliable scientific records of the atmosphere, the pioneers of the kite movement, who were Mr. Douglas Archibald and the President of our Society, should be remembered. In 1896, Major Baden-Powell became the Honorary Secretary of the Aëronautical Society, and in the next year published the first number of the quarterly illustrated *Aëronautical Journal*. His zealous work in the cause of aëronautics, as Honorary Secretary of the Society and editor of its journal, was maintained until the outbreak of the Boer war, in 1899, interrupted his peaceful aeronautical labours. But during the war in South Africa, he had opportunities of testing the value of his portable kites for wireless telegraphy, work that has already been the subject of comment in this journal. Amongst Major Baden-Powell's writings are, "The action of a bird's wing" (Chicago Conference on Aërial Navigation, 1893); "Ballooning as a Sport," Blackwood's Magazine (1895); "Man-lifting Kites," National Review (1896): "The Conquest of the Air," United Service Magazine (1897).

In March, 1898, Major Baden-Powell read an exhaustive paper before the members of the Society of Arts on "Kites in theory and practice," for which he obtained the Society's silver medal.

The Balloon Centenary at Bath.

Owing to the enterprise and hospitality of Mr. Patrick Alexander, the Secretary for Great Britain of the International Aëronautical Commission, on Tuesday, September 8, the centenary of the first balloon ascent made in Bath by Garnerin in 1802, was celebrated in Sydney Gardens, Bath, by a balloon ascent at the very hour (6.10 p.m.) on which Garnerin ascended a hundred years ago.

There was a truly representative gathering present to witness the ascent, including Major Baden-Powell, the President of the Aëronautical Society of Great Britain, Major F. C. Trollope, Vice-President of the International Aëronautical Commission, Mr. Eric Stuart Bruce, the Honorary Secretary of the Aëronautical Society of Great Britain, the Hon. C. S. Rolls, a promoter of the Aëro-Club, Dr. Barton, Messrs. Young, Groombridge and Cody, and others.

At 4.20 the proceedings opened by the dispatch of a small sounding balloon duly equipped with self-recording instruments, and at five o'clock a pilot balloon was released to test the strength and direction of the wind. At 6.10 the Alexander balloon, of 35,000 cubic feet of gas, with Messrs. Gaudron and Poole in the car made what has been described as a "majestic" ascent in the still atmosphere which favoured the occasion, clearing the large tree which occupied a rather menacing position, and taking a westerly direction.

In the evening Mr. Patrick Alexander sumptuously entertained the assembled guests at dinner. The room in which the pleasant gathering was held bore tasteful emblems of the occasion. A beautifully-made model of a

balloon with car complete floated in the centre of the room, while even the cakes of the dessert were in the shape of tiny balloons; the same emblem of the occasion was engraved upon the menus before the guests. During the dinner came the welcome news of the descent of the Alexander balloon at Chew Magna, and a telegram with information of the finding of the sounding balloon and its instruments. Not very long afterwards Mr. Gaudron entered the dining-room, having returned from the aërial trip in time to partake of some of the festivities.

But the pleasant proceedings did not terminate with the day of the balloon centenary celebration. They were most agreeably prolonged into the next. On Wednesday morning the party drove out to Mr. Alexander's experimental works at Batheaston, to enjoy a programme of aëronautical demonstration. Great interest was afforded in viewing Mr. Alexander's varied collection of aëronautical apparatus, but the *pièce de résistance* was the flight of Mr. Cody's kite. The easterly wind blowing was favourable for this demonstration, and the large kite of some 20 feet in length ascended steadily into the air, a mile of wire being let out. When up, it remained almost motionless. Small kites were sent up along the wire to the larger kite. One of these carried a charge of gun-cotton, which duly exploded at a height. After the flight of Mr. Cody's kite the party again partook of Mr. Alexander's hospitality at lunch. Afterwards another sounding balloon was despatched. It was late in the afternoon before the guests dispersed, more than ever convinced of the fascinations of the science to which they have become devotees.

The St. Louis Airship Competition.

The Louisiana Purchase Exposition has appropriated the sum of Two Hundred Thousand Dollars for an Aëronautical Competition and Exhibition. Of this the sum of ONE HUNDRED THOUSAND DOLLARS is offered as a grand prize, to be competed for and awarded under the rules and conditions hereinafter prescribed. Fifty Thousand Dollars has been appropriated for minor and subsidiary prizes for competition between airships, balloons, airship motors, kites, etc. The remaining Fifty Thousand Dollars is reserved for the expenses incident to the competition.

Rules and Regulations

GOVERNING COMPETITION FOR THE GRAND PRIZE OF $100,000.

(*a*) The Competition is open to all, without limitation as to the power used or the mechanical principles involved.

(*b*) No applicant shall be admitted to the Competition who does not present satisfactory evidence of having at some time made a flight over at least a mile course and return, with a machine similar in principle to that which he proposes to use in the Competition. The submission of this evidence may be delayed to within ten days of the first competitive trial if reasonable cause for such delay seems to exist. The Aëronautical Jury may rule out, after due investigation, any machine deemed too hazardous to life.

(*c*) All preliminary entries shall be considered as confidential.

(*d*) No vehicle shall be admitted to the contest which requires any permanent and visible connection with the earth or which is not absolutely free in its flight after the start has been made.

(*e*) As an evidence of good faith, an entrance fee of Two Hundred and Fifty Dollars ($250.00) will be required, which will be refunded when the exhibitor occupies the space assigned him with an apparatus conforming to the rules.

(*f*) Each vehicle shall carry at least one person in its flight.

II.

GRAND AND MINOR PRIZES.

(*a*) The competitor making the best average speed in strict accordance with these rules and regulations, provided that he has made the entire course three times at an average speed of not less than twenty miles an hour at each time, shall be awarded the grand prize of One Hundred Thousand Dollars, together with a suitable diploma, medal or certificate.

(*b*) There will be four minor prizes, consisting as follows: First prize, $3,500; second prize, $3,000; third prize, $2,000; fourth prize, $1,500. These shall be awarded in order of speed to the four competitors coming nearest to the record of the winner of the grand prize; provided that each of them shall, at least, have made the full course three times, and each time at an average speed of at least ten miles an hour. Each winner of one of these prizes shall receive a suitable diploma, medal or certificate recording his achievement

III.
THE COURSE.

(*a*) The prescribed course will begin and end in the athletic amphitheatre adjoining the aëronautic stabling ground in the Exposition enclosure. If for any reason this appears to be impracticable the Aëronautical Jury may permit the start and finish to be from other parts of the aëronautic enclosure.

(*b*) The course will be shaped like the letter L—one leg being the shorter and in full view from all parts of the Exposition grounds. It will be marked by three captive balloons (at points marked A-1, A-2 and A-3 in diagram herewith). The starting point will be the angle B. The aëronaut shall have his choice of the direction in which to start, but he shall turn round the captive balloons A-2 and A-3 in opposite directions; *i.e.*, one to the right and the other to the left.

(*c*) The length of the entire course will not be less than ten miles (16 kilometers) nor more than fifteen miles (24 kilometers) reckoned in an air-line from centre to centre of the captive balloons, the exact length and direction being determined and accurately measured by the International Jury having charge of the contests.

IV.
AWARD DETERMINED BY SPEED.

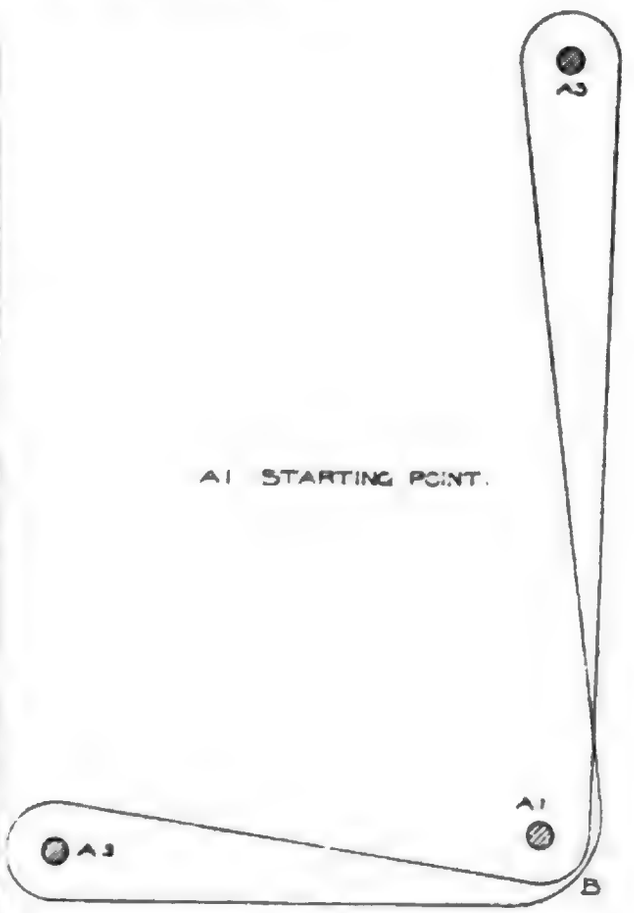
(*a*) The grand prize shall be awarded to the competitor whose average speed during his three fastest trips around the course shall be the greatest, according to the rules and regulations.

(*b*) Every competitor will have the privilege, at any trial, of passing over the course, without stopping, as many times as he desires in a continuous flight, and in such case his time as recorded by the judges shall be the average time in which he covers the full course, but this shall count as but one trip.

(*c*) Every competitor may make as many trials as he chooses, within the hereinafter prescribed dates. No trial will be considered by the judges in which he does not go around the prescribed course once, and the navigator must make, during the period allotted for the contests, at least three complete trips around the course. The average time made on each of his three best trips must be at the rate of at least twenty miles an hour, including the time consumed in the starting and landing, reckoned from the time the vehicle parts free of the ground or starting stage, until his car again touches the earth within a radius of fifty yards from the starting point without serious injury to either man or apparatus.

(*d*) Each contestant's official time shall be the average of the records of his three best trips.

(*e*) The average speed of the machine shall be computed for the actual air-line distance over the ground, making no allowance for the wind or for deviations from straight lines to or from the captive balloons.



Plan of Course for Competition for Grand Prize of $100,000.

V.
TIME OF COMPETITIVE TRIALS.

(*a*) The competitive flights must take place between the first day of June and the thirtieth day of September, 1904, inclusive. The specific weeks for the trials will be determined by the International Jury and announced in advance. Each competitor must make at least one trial within each of said weeks, but he may choose his own day or days, which must be days on which the Exposition gates are open to the public, and such choice must be announced to the judges before midnight of the day previous so that announcements may be published in the morning papers.

(*b*) The start must be made between ten o'clock a.m. and sunset.

(*c*) If, on September 30th, it shall appear that two or more competitors have made equal records, the jury shall prescribe a further trial or trials, under the same rules and regulations as have governed the preceding contests.

(*d*) The successful competitor must give three exhibition flights after September 30th, but the award shall be in no way affected by the success or failure of such exhibition. In order, however, to insure such exhibition taking place the Exposition Company may withhold thirty per cent. of the total grand prize and pay one-third of the amount thus withheld to the successful competitor after each of said three exhibitions.

Rules and Regulations

GOVERNING OTHER AERIAL CONTESTS BY AIRSHIPS, BALLOONS, ETC.

I.

AIRSHIPS NOT CARRYING OPERATOR AND GLIDING MACHINES.

(*a*) A prize of Twenty-five Hundred Dollars ($2,500.00) is offered for the flying machine, not carrying an operator, making a straight-away run of one mile and return to approximately the starting point, in the shortest time of actual flight. In addition to the weight of the complete machine, with all its appurtenances and fuel, it must carry a load of ten pounds. The details of the time of this contest will be determined by the International Jury. The judges will establish two parallel base lines, one-fourth of a mile long and at least one mile apart. These lines will be laid out on the day of the trial and with reference to the prevailing wind, if any. The machine will be started from the centre of the leeward base line and at right angles to it, and shall proceed against the wind. It shall cross the other base line before landing, and may then be caught and started back from the centre of the windward base line, proceeding down the wind and crossing the leeward base line, practically as indicated by the diagram herewith. The judges may in their opinion order that the competition for this prize shall be made in a calm.

(*b*) A prize of Two Thousand Dollars ($2,000.00) is offered for the gliding machine, mounted by an operator, which shall advance in a calm or against the wind at a vertical angle most acute with the horizon. It shall make at least twenty glides of not less than four hundred feet each. A prize of One Thousand Dollars ($1,000.00) is offered for the gliding machine, mounted by an operator, exhibiting the best automatic stability in the wind during at least forty glides not less than four hundred feet each, under rules to be prescribed by the judges. Each competitor may provide special appurtenances for starting and landing, at his own expense.

II.

MOTORS FOR AIRSHIPS OR DIRIGIBLE BALLOONS.

A first prize of Twenty-five Hundred Dollars ($2,500.00) and a second prize of One Thousand Dollars ($1,000.00) are offered for the airship motors other than the exact machine winning the grand prize, having the least weight and greatest efficiency in proportion to their power. There are no limitations as to the kind of type, but the motor must have a minimum capacity of one-brake horse-power and shall not exceed a maximum of 100-brake horse-power. The weight of the motor is to include all appurtenances (tanks, water, etc.) and fuel, or its equivalent, for a run of one hour. It must be so constructed that it can be attached to an apparatus for making a brake test. The first test will cover one hour's run to determine power, and the second test a continuous run of ten hours for ascertaining the reliability and durability of the apparatus.

III.

One prize of Three Thousand Dollars ($3,000.00) for a successful attempt to drive an airship motor by energy transmitted through space, either in the form of electric radiation or in some other form of electrical energy, to an actual amount of one-tenth of a horse-power at the point of reception and at a distance of at least one thousand feet. The test must be made on the Exposition grounds by experts satisfactory to the jury.

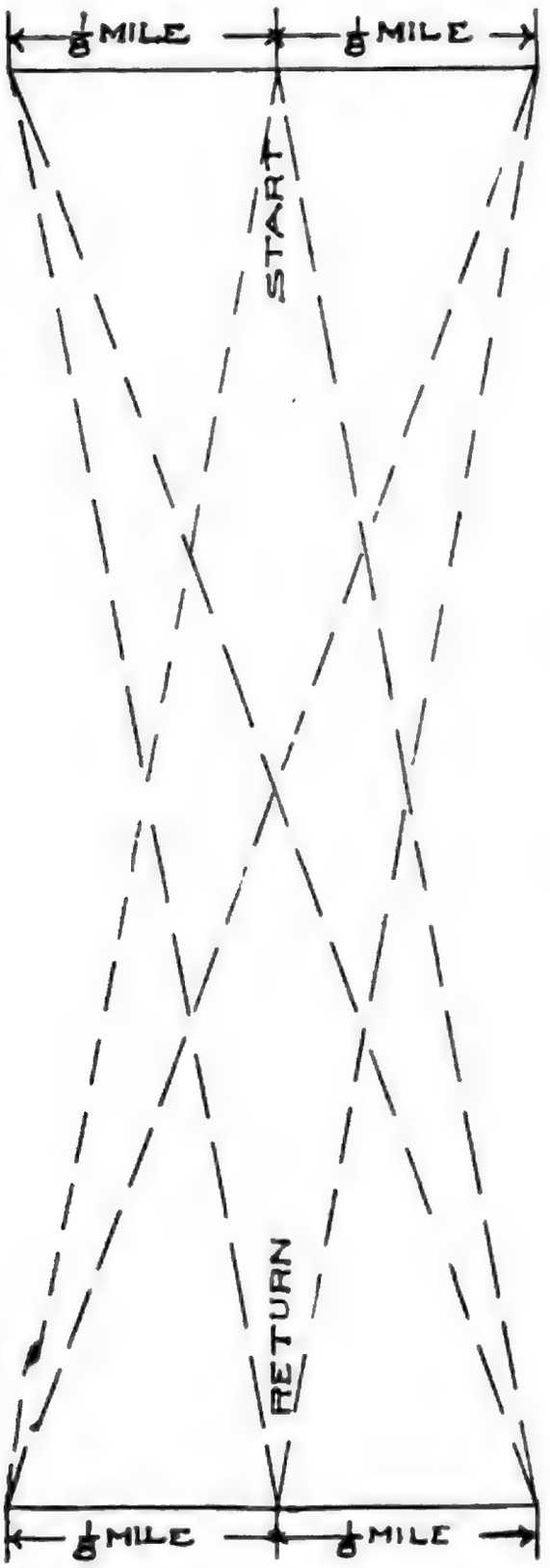
IV.

BALLOON AND AIRSHIP CONTESTS.

Four prizes of Five Thousand Dollars ($5,000.00) each, are offered to the aëronauts who win in the following contests—each being the first and only prize in its class. These contests will be open to balloon and airships or aëronautical vehicles of any type, carrying at least one person.

(*a*) For the greatest altitude attained, starting from the Exposition grounds.

(*b*) For the longest time in the air, starting from the Exposition grounds.



PLAN OF COURSE FOR FLYING MACHINE NOT CARRYING OPERATOR.

(*c*) For landing nearest to the Washington Monument in the City of Washington, D. C., the start being made from the Exposition grounds, in St. Louis.

(*d*) For the longest distance travelled in one flight in any direction, starting from the Exposition grounds.

(*e*) Time—These four contests will take place on four different dates, to be announced by the jury at least six days before the dates, on which every contestant must start.

(*f*) In the race to Washington, D. C., each contestant may make as many subsequent trials as he may choose prior to the first day of November, 1904, at which time the prizes shall be awarded.

(*g*) Entry Fee—An entry fee of Two Hundred and Fifty Dollars ($250.00) will be required in each of these four contests, the fee to be returned after the competitor takes possession of his space and is ready for the competition.

VI.

GENERAL REGULATIONS APPLYING TO ALL AËRONAUTIC CONTESTS.

(*a*) The conduct of the contests will be in the hands of an International Jury, to be hereafter constituted, but will be subject to these rules and regulations:

(*b*) No hot-air balloons will be permitted.

(*c*) The Exposition Company will provide suitable enclosure for the aëronautic grounds, and defray all necessary operating expenses connected therewith, but each competitor must provide any special structure or apparatus required by his exhibit, at his own expense.

(*d*) The Exposition will provide at cost price all gas and fuel that may be required by the competitors at the expense of the competitors, and no competitor will be allowed to provide his own fuel or manufacture his own gas.

(*e*) In case of unfavourable weather conditions on the dates set the judges may postpone the contests or order them to be repeated.

Obituary.

SIR FREDERICK ABEL, BART.

Though the late Sir Frederick Abel was a specialist and had the reputation of being the greatest living authority on explosives, he showed throughout his life that it is possible to be a specialist and yet extend sympathy to most varied departments of science. The loss of Sir Frederick Abel will be most keenly felt by

the scientific world generally, and more especially by those numerous scientific institutions to which he devoted himself with heart and soul.

Not only was Sir Frederick Abel a member of the Royal Society, but he was the recipient of a gold medal in 1887 from that illustrious body. For nearly half a century he had been actively connected with the Society of Arts. In 1868 he was elected on the Council; and as time went on, served as Vice-President and Chairman. In 1891 he was the recipient of the Albert Medal. In 1886 he was appointed organising Secretary of the Imperial Institute, though, subsequently, he gave up the remuneration of that office and became Honorary Secretary and Director.

But it is his connection with aërial matters that demands notice in this journal. It was the developments of electric balloon signalling that specially attracted the acute perceptions of Sir Frederick Abel. He at once realised that signalling at an altitude by making military signalling independent of the configuration of the country, gave it a new and important character. Almost immediately after Mr. Eric Stuart Bruce gave his first demonstration of his electrical signalling balloon at the Albert Palace in 1885, Sir Frederick Abel, being on the Government Committee which attended to these matters, urged that the invention should have the immediate attention of the Government, and obtained a Government grant for the inventor to carry on experiments for the War Office; experiments which resulted in orders from the British Government, an example quickly followed by several other Powers.

In his Presidential address before the British Association, he spoke of the flashing of incandescent electric lamps in mid-air from the ground as one of the triumphs of electricity. It was Sir Frederick Abel, too, who, on the occasion of the opening of the Yachting Exhibition at the Imperial Institute, personally conducted the King, then Prince of Wales, to the gallery, in which demonstrations were being given of the value of the signalling balloon in naval operations. Through his enterprise, too, was delivered the lecture at the Imperial Institute in 1897 on the adaptation of electric balloon signalling to Arctic exploration.

Side by side, with his scientific abilities, Sir Frederick Abel displayed sterling qualities. He acknowledged merit for merit's sake when he saw it, nor did he hesitate to speak of others the kind word where it could avail.

NOTES.

Professor Langley's New Experiments.—All interested in the progress of aërial navigation by bodies heavier than air will be glad to hear that Professor Langley is conducting experiments for the American Government. He is not prepared yet to make results of his experiments public; but during an interview with the Honorary Secretary of the Aëronautical Society of Great Britain last month in London, he said that he considered we are within measurable distance of a great advance in aërial navigation, and that in two years' time we might expect to witness important results. The Professor expressed his keen interest in the projected experiment of Dr. Barton, in which the latter intends to combine aëroplane and balloon. Though Professor Langley has hitherto himself been the Apostle of the body heavier than air, he considers that those inventors who employ the balloon in a subsidiary sense—as a lifebuoy, with the intention of reducing by degrees the balloon portion of the apparatus till only a body heavier than air remains, have reason on their side. He expressed his admiration for M. Santos Dumont, whom he described as a man of great ability. Speaking of the late M. Severo's death, incidentally, he remarked that though the navigable balloon had not been in his line of thought, he saw no reason against the view expressed by the author of one of the papers at the last meeting of the Aëronautical Society of Great Britain, that possibly the safest place for the motors in a navigable balloon might be the interior of the gaseous envelope.

The Journey of the Mellin Airship Across the Metropolis.—In the last number of this journal there appeared a description of the Mellin airship, which accomplished a journey from the Crystal Palace to Harrow on September 19. The journey reflects great credit on Mr. Stanley Spencer, who has redeemed Great Britain from the reproach that no one in this country had made a journey in a navigable balloon. It has now been claimed that Great Britain now holds the record in airship achievements, the aëronaut having estimated that taking into account his numerous evolutions he traversed 30 miles in his airship. But this opinion opens a controversy. In 1885 from Meudon took place the first return journey by Captains Krebs and Renard in their electrically-propelled balloon. They may claim

that a return journey to the place where the balloon started is a greater feat than a journey across a capital when it is not absolutely clear how much the aërial currents encountered aided or hindered the course. M. Santos Dumont, too, will, perhaps, claim that he still holds the palm, as he made a journey up to time under stated conditions. But to the scientific mind the real test of progress is the wind force overcome. The virtue of a navigable balloon is shown, not when it drifts with the wind, but when it is set in the teeth of the aërial current. Mr. Spencer certainly showed that his balloon could be steered, for he made evolutions around a church spire and so forth, which set the matter beyond doubt. But he cannot be said to hold the record of progress until it is known whether the wind forces he combated in making these evolutions were in excess of those overcome by previous experimenters. This is not likely, from the anticyclonic condition on the day on which the experiments were made, and prudently awaited for months by Mr. Stanley Spencer. It does not appear that any steps were taken to secure scientific measurement of the atmospherical conditions. The absence of these tests on such occasions is to be regretted, as the experimenter loses the advantage of figures which, alone, can give him his exact position in the history of progress. Some very excellent photographs of London and the neighbourhood were taken by Mr. Spencer from the airship. Four of these appear in the "Illustrated London News" for September 27.

The Navigable Balloon Scheme of M. Torres.—In August last a note appeared in "Nature" on the project of M. Torres for making a navigable balloon with an interior keel. The object is similar to that which inspired the late M. Severo, viz., to bring all the forces acting on the balloon into the same horizontal line. M. Torres proposes to make a balloon with several compartments, containing a central beam suspended in its interior and forming with its attachment a rigid internal keel. The propeller is to be attached to the end of this beam-end. The car is to be very small and close up to the balloon. We must, however, agree with "Nature" that with such a terrible example in our recent memory as the fate of M. Severo, the proximity of car and its motors to the balloon raises misgivings, if petroleum is to be the source of power.

The Investigation of the Upper Atmosphere by Means of Kites.—The Committee on "the investigation of the upper atmosphere by means of kites," made a report on their useful work at the meeting of the British Association at Belfast. It has been decided to make the kite observations either in thinly-inhabited parts of the country or over the sea, so as to reduce the risk of any accident to a minimum. Since nothing was known of the vertical temperature gradient over the great oceans, and this knowledge was of supreme importance for theoretical meteorology, it has been decided to work on the west coast, since the prevailing westerly winds make observations in such a locality equivalent to those taken over the sea. It was thought desirable to take some observations at the same height as Ben Nevis, somewhere on the coast in the neighbourhood of Ben Nevis, so that light might be thrown on the question as to how far the temperatures taken on a mountain summit differed from the temperature of the free air in the surrounding districts at the same level. It was decided to fix the apparatus at Crinan, about 30 miles south of Oban. The kites employed differed in form from those employed at the Blue Hill Observatory, in the United States. The highest record of height for the kites had been 11,450 feet, when 21,000 feet of wire was employed. The temperature gradient observed on that occasion was approximately two and a half degrees (Fahr.) for every thousand feet of ascent. The experiments are to be conducted for another year, during which it is hoped that flights may be arranged so as to obtain exact information regarding the distribution of temperature and humidity in specific conditions of weather; thus the physical processes taking place in the upper air corresponding to weather changes noted at the surface could be examined. We may add the hope that such valuable experiments with kites may not only be carried on for one more year, but every year.

The Recent Balloon Voyage of Comte Henri de la Vaulx.—The second attempt of Comte Henri de la Vaulx to cross the Mediterranean in his balloon has ended like the first, without the accomplishment of the object. On September 21, Comte Henry de la Vaulx, accompanied by M. Castillon de Saint Victor, M. Laignier, and M. Hervé, started from the Aërodrome, at Palavas les Flots, near Montpellier, in the balloon "Méditerranée II." The balloon was provisioned for several days and was escorted by the torpedo destroyer "Epée, being attached to the deviator, which

Digitized by Google

kept it at a uniform height of 100 feet above the water. At 10 o'clock on the morning of September 22, the balloon was sighted by the captain of an Italian vessel, twenty-five miles south-east of Palavas. Eventually a contrary wind caused the attempt to be abandoned, and the descent was made at Marseillan, between Atte and Agde.

REVIEWS.

Aerial Navigation.

BY FREDERICK WALKER, E.E., LONDON, CROSBY, LOCKWOOD AND SON.

A new book on aërial navigation has been made by Mr. Frederick Walker, C.E. It contains a large fund of information respecting the designs and devices of comparatively unknown inventors of aërostats, airships, and flying machines; and though it is "a practical handbook," it is not made clear to the reader which of the many contrivances mentioned have proved of practical value to the science of aëronautics, and which have never got beyond the Patent Office. To the practical student, therefore, the book must be obscure. Even when the case of a machine that has been tried is mentioned the reader is left in absolute doubt as to the result. In chapter VIII., in speaking of Partridge's airship, the author says, "it made several *successful* flights." Considering the *successful* flights of airships have been few, how useful it would have been to the student to know in what lay Partridge's "success."

One fact we may say with certainty about Mr. Walker's book is that the author has not been careful to secure accuracy. The very first page opened by the reviewer contains the following surprising statement. Speaking of modern airships on page 133, Mr. Walker says, "Dr. Barton, in the United States, has just built an airship, the trial of which has not yet been reported!" Now, Dr. Barton is an Englishman, who frequently takes the chair at the meetings of the Institute of which Mr. Walker is an associate member. He is not building an airship in the United States, nor has he yet built one at all, beyond preliminary models. He is, however, soon going to commence to build an airship in this country at the request of the British War Office. Nearly every British newspaper, London and Provincial, has published the true facts of the case. A glance at the *Aëronautical Journal* for April last would have revealed Dr. Barton's own paper on the subject, read before the members of the Aëronautical Society of Great Britain in March last. Though, in this book, accounts and criticisms of M. Santos Dumont's experiments are sparse, pictorial illustrations of the famous Brazilian aëronaut's aircraft are largely employed to enhance the make-up of the volume. M. Santos Dumont forms the subject of illustration for the outside cover, for the frontispiece, and on several pages of the book. There will soon be a market for works on aëronautics, but they must be lucid and sound if they are to enhance the popularity of the subject.

Foreign Aëronautical Periodicals.

(In this list a selection of some of the more notable articles is given.)

L'AÉRONAUTE (Paris).

July, 1902.—Rapport sur le Duquesne, Ballon à hélices de L'amiral Labrousse.

August.—Rapport de M. Cassé sur L'aérostat automobile de M. Josselin; Mémoire sur le propulseur Bataille.

L'AÉROPHILE (Paris).

July, 1902.—Portraits d'Aéronautes contemporains: François Hulka (Louis Cermák); Ascension Tragique (Henri Gaspard); La perméabilité nasale observée en ballon Dr. Consteau); La Volateur de M. Schmatz (Georges Blanchet).

September.—Portraits d'Aéronautes contemporains: Emile Janets (Wilfrid de Fonvielle); Rapport sur un mémoire de M. Torres, concernant un avant-projet de ballon dirigéable (Appell); Le ballon du Capitaine Unge (G. Blanchet).

L'Aéronautique.—Bulletin officiel de L'Aéronautique: Club de France (No. 2.); La Sécurité en ballon à moteur (M. Ed. Surcouf).

ILLUSTRIRTE AËRONAUTISCHE MITTHEILUNGEN (Strassburg).

July, 1902.—Die Entwickelung der Luftschiffahrt in Deutschland (paper read before the Aëronautical Society of Great Britain, March 11, 1902;) Wie verhält sich de Drachenballon bei einer Freifahrt? (A. Riedinger); zur Berechnung der Steighöhe eines Fesselballons; Blitzschlag in einen Fesselballons; Die Katastrophe des "Pax" am 12 Mai; Theoretische Grundlagen für die Construction eines Schraubenfliegers (Dr. O. Martleussen).

WIENER LUFTSCHIFFER-ZEITUNG (VIENNA).

August, 1892.—Ballons in der Marine; Grundzüge der praktischen Luftshiffahrt (Victor Silbur); Carton Uber Severo.

September.—Von Augsburg nach Russland; Zur Frage der Flugflächenform; Der Wettbewerb in St. Louis.

THE AËRONAUTICAL WORLD (Glenville, U.S.A).

August.—The Conquest of the Air by Man; The Fallacy of Balloons; A Simple Aërial Machine; The Aërial Transit of Man; Leo Stevens's Airship.

September.—Practical Flying Machines; The Stanley Airship; Irish's Aërial Machines; Motorless and Motor-driven Aërial Machines; Hargreaves' Flying Machine; The Art of Flight.

Notable Articles.

July, 1902.

16. *Daily Mail*.—"Child's Balloon Journey."
— *English Mechanic*.—"The Future of the Flying Machine."

Aug. 12. *Edinburgh Evening Dispatch*.—"Experiments in Kite Flying."
— *Daily Chronicle*.—"Crossing the Channel."
20. *Electricity*. — "Professor Bell's Flying Machine."
26. *Pall Mall Gazette*.—"Santos Dumont and the St. Louis Exhibition."
— *New York Herald*.—"Perilous Balloon Ascent."
29. *New York Herald*.—"M. Santos Dumont's coming Airship."
30. *Daily Graphic*.—"The Graphic Balloon."

Sep. 1. *Daily Graphic*.—"Strategic Ballooning"
— *Standard*.—"Balloons in Warfare."
5. *New York Herald*.—"Trying to conquer the Aërial World."
13. *Times*.—"By Sky across the Irish Channel," letter to the Editor by Rev. John M. Bacon.
20. *Daily Telegraph*. — "Airship across London."
22. *Times*. — "The Airship Journey across London."

Applications for Patents.

(*Made in July, August and September*, 1902).

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.

14405. June 25. FREDERICK MALFAIT. **Improvements in Navigable Balloons.**

15403. July 10. EMILE NÉMETHY. **Improvements in Flying Machines.**

16698. July 28. DONAT SAMPSON. **Improvements in Flying Machines.**

17068. August 1. EDWARD MANN and CHARLES ARTHUR ROLLASON. **Improvements in and connected with Flying Machines and Dirigible Balloons.**

17252. August 5. EMIL THEODOR BRAARUP. **Improved means of inflating Indiarubber Balloons.**

17286. August 6. ANTON WECZERA and LEWIS WELLS BROADWELL. **Improvements in Flying Machines.**

17383. August 7. JOHN NEVIL MASKELYNE and JOHN MACKENZIE BACON. **Improvements in Hot Air Balloons.**

17499. August 8. SIDNEY JOHN LAWRENCE. **Improved Air-Ship.**

17661. August 12. RAFFAELE RONCO. **Improvements in Steering Devices for Air-Ships and Submarine Boats.**

17844. August 14. FREDERICK WILLIAM BISHOP. **Improvements in or in connection with Navigable or other suitable Balloons.**

18248. August 19. JOHN SIGISEMAN RYAN. **An Improved Flying Machine.**

18453. August 22. ANNIE LOUISE VEALE, CLEMENT PEARCE CADLE, RICHARD PELFORD, and ADDISON BRIGHT EVANS. **A Parachute used as a Toy or as a Moving Target for Sportsmen.**

19137. September 1. A. STANNARD CUBITT. **Automatically Releasing Apparatus for use with Kites, Captive Balloons and the like.**

THE

AËRONAUTICAL JOURNAL.

A QUARTERLY ILLUSTRATED MAGAZINE DEVOTED TO ALL SUBJECTS CONNECTED WITH THE NAVIGATION OF THE AIR.

VOL. VII.

1903.

PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN AND PRINTED BY KING, SELL, & OLDING LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, LONDON, W.C.

AËRONAUTICAL JOURNAL.

VOL. VII.

INDEX.

PAGE

Aëronautical Society, Notices .. 1, 21, 45, 63
,, ,, General Meetings 1, 2, 25, 45
Kite Equipments of the Scottish National Antarctic Expedition, By Mr. J. Anderson (Illustrated.)
,, ,, Presidential Address, By Major B. F. S. Baden-Powell 3
Airship of the Brothers Lebaudy 17
,, Model, Prof. Langley's 11
Aërography in Berlin 18
Aëronautical Nomenclature 41
"Aërosac"—Mr. Patrick Alexander 28
Aëronautical Exhibits 79
,, Exhibitors 81
Alexander, Mr. Patrick 28
Aëronautical Apparatus, Exhibition 61
Ascents, International Balloon .. 16, 40
Balloon Clubs 17
,, End of M. Roze's 41
British Association, Southport Meeting—
Exhibits 79
Berlin, Aërography in 18
Brothers Lebaudy, Airship of the 17
Blackden, Major L. S. 54
Bruce, H. Auxilium 41
Ballooning, Cross-sea 79
Balloon Ascents, International 16, 40
Bacon, Rev. J. M. 18

PAGE

Commission, Permanent International Aëronautical 40
Contributions of Balloon Investigations to Meteorology, by Dr. W. Napier Shaw, F.R.S. 8-13
Count Henri de la Vaulx's Balloon Touring from Paris to Hull 81
Cross-sea Ballooning 79
Cycala Flying Machine (Illustrated) .. 13-16
Clubs, Balloon
De Bradsky Airship—A Short Account of its Development and the Causes that led to the Accident in 1902 (Illustrated) 66
Discovery, The, Observation Balloon 41
Exhibition of Balloon Photography 18
End of M. Roze's Balloon 41
Experiments Relative to Equilibrium and Angle of Fall in Gliding Flight—Major L. S. Blackden, with diagrams .. 54-61
Exhibition of Aëronautical Apparatus—Messrs. Groombridge and South's .. 61
Excelsior—
Exhibits—Southport Meeting 79
Fatal Accident to M. de Bradsky 16
Flying Machine "Cycala" (Illustrated), .. 13-16
Glaisher, Mr. James, the late 22
International Balloon Ascents 16, 40
Kite Competition, International (Illustrated), with List of Competitors 1, 21, 46
International Kite Competition, with List of Competitors (Illustrated) 1, 21, 46

Digitized by Google

	PAGE
Late Mr. James Glaisher (with Portrait) ..	22
Lebaudy Airship (Illustrated)	76-78
Langley, Professor	11
M. Santos Dumont's New Airship	40
,, ,, Present to the French Government	80
M. Santos Dumont's Navigable Balloon ..	49
Message Balloons in Polar Expeditions ..	16
New British Airships :—	
I.—Spencer Airship	74
II.—Dr. Barton's Airship	74
Nomenclature, Aëronautical	41
Navigable Balloon, M. Santos Dumont's ..	49
Observation Balloon of the *Discovery*	41
Observations and Experiments Relative to Equilibrium in Air of a Body Heavier than Air—Major L. S. Blackden	28
Presidential Address—By Major B. F. S. Baden-Powell	3-8
Permanent International Aëronautical Commission	40
Professor Langley's Airship Model	11
Photography, Exhibition of Balloon	18
Reviews—The Greatest Flying Creature, By S. P. Langley	18
"Illustrated Scientific News" ..	18
The Dominion of the Air, By the Rev. J. M. Bacon	18
Die Luftschiffahrt der Gegenwart, By H. Auxilium Bruce ..	41
Sahara Balloon Experiment	41
Sailing Flight of the Turkey-Buzzard—T. H. Hugo	72
St. Louis Exhibition	75
Stanley Spencer's Navigable Balloon Journey.	80
Shaw, Dr. W. Napier, F.R.S.	8-13
Wind Forces Overcome, Experiment by M. Santos Dumont with his Navigable Balloon in Paris, 1901, with Charts..	49



Digitized by Google

20.5
245

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH.
AUG 4 1910

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain.
By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 25. JANUARY, 1903. VOL. VII.

All Rights Reserved.]

Contents.

PAGE.

NOTICES OF THE AËRONAUTICAL SOCIETY 1

THE INTERNATIONAL KITE COMPETITION 1

GENERAL MEETING OF DECEMBER 4th, 1902—

REPORT OF SESSION, 1901-1902 2

PRESIDENTIAL ADDRESS—"RECENT AËRONAUTICAL PROGRESS AND DEDUCTIONS TO BE DRAWN THEREFROM REGARDING THE FUTURE OF AËRIAL NAVIGATION." By MAJOR B. F. S. BADEN-POWELL 3-8

"CONTRIBUTIONS OF BALLOON INVESTIGATIONS TO METEOROLOGY." By DR. WILLIAM NAPIER SHAW, F.R.S. 8

THE CYCALA FLYING MACHINE. By Dr. CHARLES ZIMMERMAN *(Illustrated)* 13

NOTES—MESSAGE BALLOONS IN POLAR EXPEDITIONS—THE INTERNATIONAL BALLOON ASCENTS—THE FATAL ACCIDENT TO M. DE BRADSKY—THE AIRSHIP OF THE BROTHERS LEBAUBY—BALLOON CLUBS—AËROGRAPHY IN BERLIN—THE EXHIBITION OF BALLOON PHOTOGRAPHY 16-18

REVIEWS—

(1).—"THE GREATEST FLYING CREATURE." By PROFESSOR S. P. LANGLEY. Reviewed by MAJOR B. F. S. BADEN-POWELL .. 18

2.—"THE ILLUSTRATED SCIENTIFIC NEWS." 18

3.—"THE DOMINION OF THE AIR." By THE REV. J. M. BACON. 18-19

FOREIGN AËRONAUTICAL PERIODICALS 19

NOTABLE ARTICLES 19

APPLICATIONS FOR PATENTS 20

LONDON:
PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

Digitized by Google

. . THE . .

Illustrated Scientific News,

A MONTHLY JOURNAL OF POPULAR SCIENCE.

PRICE 6D., OR 7S. ANNUALLY.

Contributed to by many of the Leading Scientific Authorities of the Day.

The Aëronautical portion being contributed by Sir Hiram Maxim, Major Baden-Powell, and Mr. Eric Stuart Bruce, M.A.

To be had of all Booksellers and Newsagents,
OR OF **KING, SELL & OLDING, Ltd., Lonsdale Chambers, 27, Chancery Lane, London, W.C.**

JUST PUBLISHED BY . . .

WILHELM ENGELMANN, LEIPZIG,

GUIDABLE BALLOONS.

Retrospects and Prospects by

CAPTAIN HERMANN HOERNES.

With 84 Figures in the Text, 6 Lithographic Plates, and numerous Tables.
XII. and 359 Pages, 8 Stitched, **15/-**

BACK NUMBERS

— OF THE —

AËRONAUTICAL JOURNAL

Can be obtained from the Publishers:

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, CHANCERY LANE, LONDON, W.C.

THE AËRONAUTICAL JOURNAL.

JANUARY, 1903.

The Aëronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

53, Victoria Street,
Westminster, London, S.W.

NOTICES
OF
The Aëronautical Society.

AT a meeting of the Council of the Aëronautical Society held at the Society of Arts, John Street, Adelphi, on Thursday, December 4th, the following gentlemen were elected members of the Society:—

MR. ALEXANDER ANDERSON.
MR. J. N. MASKELYNE.
HERR JOSEPH HOFMANN.
MR. WILLIAM COCHRANE.
MR. FRANCIS HERNAMAN-JOHNSON.
MR. H. GRUNAU.

GENERAL MEETING.

The next general meeting of the Aëronautical Society of Great Britain will be held at the Society of Arts, John Street, Adelphi, in March or April next. Amongst the papers read will be one on "The Kite Equipment of the Scottish National Antarctic Expedition," by Mr. John Anderson (with Lantern Illustrations), "The Aerosac," by Mr. Patrick Y. Alexander, and "Observations and Experiments relative to Equilibrium in Air of a Body Heavier than Air," by Major L. S. Blackden.

INTERNATIONAL KITE COMPETITION.

There will be an International Competition for the Highest Kite Flight, under the auspices of the Aëronautical Society of Great Britain, in June next. The award will be the Silver Medal of the Society. The site selected will probably be on the Sussex Downs, and arrangements will be made for a general meeting of the Aëronautical Society to be held at the appointed place to witness the competition.

The following are the general rules drawn up by the Council of the Aëronautical Society of Great Britain:—

1. The Competition is for the highest flight attained by a single kite beyond 3,000 feet.
2. Duration of flight to be one hour, and kites must be sustained in the air during this period.
3. Each kite must carry a weight of two pounds.
4. The height to be determined trigonometrically from the ground.
5. The Competition is open to all ap-

Digitized by Google

proved by the Council of the Aëronautical Society of Great Britain, without limit of form of apparatus, and each Competitor must provide his own apparatus, winding gear, etc.

5. Each Competitor is to be held responsible for any damage or accident that might occur to or by means of his apparatus.
6. Members of the Aeronautical Society of Great Britain will have to pay no entrance fee, but for non-members there will be an entrance fee of half-a-guinea.
7. Not less than two Competitors can enter for the Competition.
8. The Jury will have the decision whether the Medal is to be awarded.
9. The decision of the Jury must be accepted as final.

In issuing these General Rules the Council reserve to themselves the right of making any additional regulation which may tend to facilitate the carrying out of the Competition.

Amongst those who have kindly consented to act on the Jury are—Sir Hiram Maxim and Dr. William Napier Shaw, F.R.S.

Members of the Aëronautical Society of Great Britain and others who wish to take part in the above Competition should communicate with the Honorary Secretary of the Aëronautical Society of Great Britain, 53, Victoria Street, Westminster, London, S.W.

CHANGE OF ADDRESS OF THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN.

Members of the Aëronautical Society of Great Britain and others are reminded that the new address of the Society is

53, Victoria Street,
Westminster,
London, S.W.,

and that all communications should be addressed to the Honorary Secretary at that address.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

The opening meeting of the new session of the Aëronautical Society of Great Britain was held at the Society of Arts, John Street, Adelphi, on Thursday, December 4th, 1902. The President, Major B. F. S. Baden-Powell, was in the chair

The President: Ladies and Gentlemen,—The Honorary Secretary will begin by reading you the minutes of the last meeting and also the report of the last session.

The Honorary Secretary read the minutes of the last meeting.

The Honorary Secretary: It is usual for the Honorary Secretary, on the occasion of the opening meeting of the session, to make some report as to the progress and work of the Society during the past year. As, however, we have a fairly substantial programme to get through this evening I propose to be as brief as possible and confine myself to merely stating facts.

1. As regards the finances of the Society during the financial year 1901-1902, our receipts, including the balance from the previous year, were £355 10s. 0½d. Our expenditure was £151 4s. 11d., leaving in hand on July 1st this year a balance of £204 5s. 1½d.

2. Regarding the membership of the Society during the last few years, this shows a steady increase year by year. We now have over one hundred members, and it is hardly necessary to state that a large proportion of these members are composed of those who are eminently distinguished in other branches of science, testifying to the value of aëronautics in widening the boundaries of scientific knowledge generally.

3. This year, for the first time in the history of the Society, first established in 1866, we have taken the step of settling down in premises of our own at 53, Victoria Street, Westminster, where will be the office and library of the Society. We are at present engaged in arranging the library at the new premises, and after it has been duly catalogued arrangements will be made for it to be open to members at stated times for reference.

4. I will say a few words about the work at the general meetings of last session. Several papers were read at our meetings of extreme value to the literature of aëronautics. Amongst them I may mention the paper by Sir Hiram Maxim on "Aërial Navigation by the Body Heavier than Air"; the paper on "Atmospheric Currents," by Mr. William Marriott; one on "Aëronautics in Germany," by Major W. L. Moedebeek; another on "Balloon

Photography," by Miss Gertrude Bacon, and a most able criticism on the late Senhor Severo's Airship by Dr. Carlos Sampaio.

5. At our concluding meeting of the session in July last, the Society passed a formal vote of sympathy with the Brazilian nation on the death of Senhor Augusto Severo in the cause of science and cosmopolitanism. On this occasion the Brazilian Minister, accompanied by the whole staff of the Brazilian Legation, was present. The vote of condolence was supported by Dr. Mills, the Secretary of the Royal Meteorological Society, on behalf of British meteorologists.

The reply of the Brazilian Minister was a philosophical commentary on balloon accidents, and might well be read and studied by those who, on account of a few mishaps, would disparage the study of aëronautics.

6. Amongst our plans for this new session on which we have entered to-day—a red letter one, for the fact that on it we have at last realised the return of our President amongst us, safe from the perils of the South African War—is the International Kite Competition to take place in June next, the award being the silver medal of the Society. In arranging this competition the Council hope they will have the co-operation of the members of this Society by an adequate response to the invitation to compete or be present. I will confine myself to mentioning two cogent reasons for endeavouring by this competition to stimulate the improvement of kites.

1. The kite is fast becoming a most valuable means of extending the boundaries of meteorology by giving facilities of observation in the free air at considerable heights.

2. The kite is, after all, the basis of what we, with reason, expect will be the future instrument of aërial navigation—the aëroplane. The more the surfaces of kites are improved so as to give greater sustaining power to the kite in the air, the nearer we shall be coming to the day when we shall sever the string and trust alone to the intelligence, motor, and propeller for balancing the aëroplane midst the diverse currents of the atmosphere.

Presidential Address.

RECENT AËRONAUTICAL PROGRESS, AND DEDUCTIONS TO BE DRAWN THEREFROM, REGARDING THE FUTURE OF AERIAL NAVIGATION.

By Major B. F. S. Baden-Powell.

It is with feelings of the greatest satisfaction that I am now able, for the first time, to address the Society in the capacity of its President, and I must seize this opportunity of expressing to you my heartfelt thanks for the very great honour which you have conferred upon me by electing me to this position. I cannot but feel that my labours in the past, though varied and dipping into almost every branch of aëronautics, have not been so extensive or so prominent as to warrant my selection for this important post, but nevertheless, I sincerely hope that, with freer opportunities, I may, in the immediate future, be able to accomplish much more in the work we have before us.

My absence from England during the last three years, on active service in South Africa, has prevented my fulfilling many important duties for the Society during a period of unusual activity and importance, but on the other hand, the time I have spent on the "trackless veldt," and in the monotony of camp life, has not, I hope, been wasted, as ample opportunity has been afforded for careful meditation and consideration of the whole subject which it is the object of this Society to study. I therefore propose not so much to give a technical lecture on the various experiments of recent years—you have had better opportunities than I of studying these—as to endeavour to make clear our present position.

During these three years many great events have taken place in the aëronautical world. Count Zeppelin's monster air-ship, built on sound scientific principles, of enormous size and quite different in design to anything made before, has been completed, and has made successful ascents, although, I much regret to have to add, has not succeeded in travelling through the air at a sufficient speed to warrant its being considered a practical success.

Then we come to M. Santos-Dumont's many more or less successful trips in his navigable balloons, which, if not demonstrating any new principles, has shown what perseverance and attention to detail can achieve. Though we have learnt some useful practical lessons, and have been given data of great value for future experimenting, unfortunately the actual results attained carry us so little beyond what was accomplished twenty years before by MM. Renard and Krebs, that one begins to think whether we have not nearly reached the end of the tether as regards the propulsion of balloons.

The unfortunate calamities to M. Severo's and more recently to M. de Bradsky's balloons, as well as the absolute failure of M. Roze and others, only tend to confirm this growing opinion. The latest accounts of M. Lebaudy's balloon seem to make out that it has accomplished more, but we must await the results of more prolonged trials before we can come to any decision. Mr. Stanley Spencer's trip over London in a navigable balloon, though it proved nothing as regards the dirigibility or inherent speed of the machine, attracted some interest in the matter.

Besides these we have heard of various experiments with flying machines proper. Herr Kress

Digitized by Google

is said to have risen off the surface of the water but owing to some mismanagement the machine turned downwards and fell in the water again. In Australia Mr. Hargrave has constructed a large machine. In America, Mr. Wilbur Wright and his brother have been making wonderful progress with gliding machines, and Professor Langley has been hard at work constructing a large new machine. He informed me the other day that in a very short time we might expect to hear something of this—something big. It might, he added, be a big smash! But he wisely intends trying it over water.

Then, too, like the invisible universe of dark stars that Sir Robert Ball talks about as being possibly more extensive than that of those seen, there are probably more inventions being worked at in private than we ever hear of publicly, and many of them are doubtless of great importance. It is only recently that the results have been published of the valuable experiments with aërial screw propellers which Mr. W. G. Walker conducted for Mr. Alexander.

Another sign of progress in the subject of aëronautics during the last few years has been the establishment in England of two more public bodies, the Aëro Club and the Aëronautical Institute, the former having been established for the encouragement of ballooning (and possibly flying) as a sport, while the latter aims at interesting the working-classes in the subject.

I may here seize the opportunity of explaining to our visitors and others the objects of our Society, and why it is that we make so much of a study which to them may seem somewhat chimerical and of no very special merit, and by explaining these I hope to enlist their sympathy and support to the movement. For I have before now been asked, "Why should it be necessary to have a society for the study of aërial navigation? Where is the importance of it? Why not institute a society for submarine navigation, for wireless telegraphy, or for the encouragement of any other novel invention for the improvement of means of communication or warfare? But useful as many such inventions may be, none can have the great importance which may some day be attached to the machine which navigates the air.

And there are two reasons why this subject is a large one. The first is that the science of aëronautics is one combining many branches and spreads into many ramifications. We have aërial machines as they exist to-day. The balloon, forming a unique and fascinating mode of travel, enabling us to mount high into the skies to obtain glorious views of earth and cloudscape, giving us a laboratory for the study of many intricate problems of the atmosphere, and forming a valuable instrument of war. We must study how this passive buoy may be improved upon, what new materials may be applied to its construction, gases, methods for causing it to rise and sink, and means of directing it out of the course of the wind. But we also have the more difficult problem of how to drive it through the air so as to make it independent of the wind and go in any desired direction. Closely connected with this is the subject of kite-flying, whether for man lifting or meteorological observation, of parachutes, and of soaring machines. All these necessitate a certain knowledge of the various branches of meteorology, which is to aëronautics as hydrography is to marine navigation. Then we have the study of birds and other flying animals as a natural sequel to the science.

The second reason for the importance of this subject is the vast future which appears open to it. If such an apparatus can be constructed as will enable man to make practical use of the highway of the air, there is promise of the subject becoming of even more importance than marine navigation or railways.

We have then not merely to consider the broad principles of the general form of the aërial machine of the future—whether it is to take the shape of an artificial bird, a propelled kite, or a dirigible balloon. We have to study the subject of aërodynamics, the effect of air pressures on plane or curved surfaces travelling at various speeds and at various angles of incidence. We have to investigate the efficiency of aërial propellers of different forms, the strengths of materials, the energy and weights of various forms of motors. Then we must also study the natural currents of air, the variability of air strata, the trends of winds, and so on.

The great range of subjects to be gone into by our Society is thus patent. Many of our members and others are busily at work in some particular groove making steady progress in building up their portion of the foundation of that great structure which we all hope to see rise up in the future.

But, to return to the question of the recent progress in Aërial Navigation, I will now endeavour to point out and explain the present position we hold, and by considering the state of the subject as it at present exists, to judge whether or not there is any real probability of our attaining that great goal which most of us look forward to.

Though it is improbable there are many here present to-night who do not look forward with feelings of confidence that artificial flight will some day be accomplished, yet there are still some few sceptics (most, if not all, of whom have never looked deeply into the subject), who believe it impossible. For this reason it may not perhaps be out of place, in such an address as this, to point out our reasons for maintaining this belief.

The first great argument in favour of it is that birds fly. If we had never seen such a thing as a bird, many of us might reasonably argue the thing to be impossible. But there they are. Not only can they rise in the air, not only progress at a very rapid rate through it, but they can continue the movement for long periods and in almost any weather. It is quite certain now that birds do not possess any very extraordinary power; but if they did, we could probably "go one better" with the modern very

compact and light oil-engines. We have now compressed the strength of a horse into a little motor weighing no more than a large bird. There is the power. Can it be applied? Many people have argued that the flight of a bird is dependent on some valvular action of its feathers. Let it be so, but how do you account for the flight of the bat, and of the flying-fox? Others have thought that flight is only possible up to a certain weight, maintaining that the ostrich and the emu are beyond that limit. But geologists will point you out the fossil remains of a huge reptile which they declare flew in the air and weighed far more.

But leaving Nature, we may consider what has been done by man to justify our hopes.

Though I believe it may be said that nearly all the authorities on the subject are now of opinion that the balloon cannot be considered as much more than an aid, to act as a stepping stone, to true flight, yet there are many workers who consider that very much may be accomplished by propelled balloons. Some authorities have calculated that a speed of 44 miles an hour might be practically attained, but not more.

M. Santos Dumont and others have shown us what can be done with a little cigar-shaped balloon. They have clearly demonstrated the difficulties to be overcome. It is very palpable that the surface of such a balloon must be stiff and rigid. Once it gets flabby it cannot be propelled, the skin will vibrate and add to the resistance, the nose, unless distended by framework, will be driven in and offer great resistance, the gas will be driven back towards the after end, and the balance be disturbed. To preserve this necessary rigidity all the earlier navigable balloons were kept taut by means of the ballonet, but Count Zeppelin effected this by an internal framework.

Count Zeppelin, as I have said, struck out a new line. By greatly increasing the size of the balloon, he had obtained so much more lifting power as to be able to add a complete framework that stiffened it. But it was probably solely owing to this great size that the apparatus failed to be practically manageable. It may be compared to the *Great Eastern* steamship, but with the difference that at the time of its construction we had but the most elementary experience of air vessels propelled by engines. At the same time this enormous capacity had its advantages. Had it been of half the diameter and half the length, though the resistance to propulsion might have been only one quarter, the volume and the lifting power would only have been one-eighth. So that, instead of carrying engines of 32-horse power as was done, it might have only been possible to carry some of 4-horse power! Dr. Pole in his most valuable little treatises years ago pointed out the advantages of very large volume.

One result, then, of recent experiments is that it seems quite practicable to build a navigable balloon to go, we will say, 15 miles an hour. This, however, is not quite enough. As the wind so often blows faster than this it is unsafe to let the balloon out on any but a very calm day, else, though only blowing 16 miles an hour, the machine will inevitably be carried off and have to descend in strange fields far from its shed and the difficulties of transporting it back may be so great that it may even have to be taken to pieces. Having successfully accomplished this much, however, it certainly looks as if we could improve a little, and get the balloon to travel 20 or 25 miles an hour, which would be sufficient to stem the ordinary light breezes.

We have learnt many practical lessons from these recent experiences. It is necessary to make efficient provision against the balloon caving in or buckling up. It is, of course, most important that the engine shall be so constructed as not by any possible means to be able to ignite the gas in the balloon. But especially we have learnt that, speaking in general terms, for a cigar-shaped vessel some 20 ft. in diameter it is necessary to apply a power of more than 16 horse-power (presuming no exceptionally efficient propeller be found) for it to be really efficient. This practically means that you must have a larger balloon.

MM. Lebaudy have now adopted a larger balloon enabling them to carry an engine of 40-horse power, or more than double the power of that of M. Santos Dumont. Col. Renard also, is about to build one larger still, of some 90,000 cubit feet. Dr. Barton's proposed air-ship is also designed to be of great size.

Passing from the balloon, that is to say any apparatus which displaces a volume of air weighing as much as or more than its own weight (and many thoughtless inventors are apt to neglect this definition) we find several different types of machines which show promise of success.

Beginning with the simplest, we have the gliding or soaring machine. One of the greatest paradoxes in Nature is soaring flight. I have said how doubtful many people might be about aërial navigation if they had never seen a bird fly, but we can confidently assert that no man would believe it possible for a bird to maintain itself for hour after hour in mid-air without the slightest movement of its wings, were the actual demonstration of it not visible every day. I will not now enter on a discussion as to how this is accomplished, but will only say that there are inventors who hope to be able to emulate the albatross, and soar away into the heavens without any motive power or propeller. It seems so paradoxical that many laugh the idea away. But the hard fact remains that birds can do it, and, therefore, why not men? I received a letter only a few days ago from Mr. O. Chanute, than whom there is probably no greater authority living on soaring flight. He says that he had just returned from witnessing this season's gliding experiments of the Brothers Wright, and that "they have made a very considerable advance since last year, and now glide at angles of 6° to 7°, sustaining 125 to 160 lbs. per *net* horse power. Wright is now doing nearly as well as the vulture, is not far from soaring flight, and I am changing

Digitized by Google

my views as to the advisability of applying a motor."

I think this is a most remarkable statement, and there really seems no reason why such experts, having attained proficiency in the delicate art of balancing themselves according to the various puffs and currents of air, should not be able to soar away on the wings of the wind and remain indefinitely in mid-air!

The next general type of apparatus that I may refer to is that of rising in the air by means of a screw propeller mounted on a vertical shaft. We all have seen little toys ascend in the air working on this principle. A large machine of this sort was recently constructed in Paris, but the experiments of Mr. W. G. Walker, of carefully testing the thrust and lifting power of various screws, have been among the most important contributions to this science. He has clearly shown that it is possible to practically obtain a thrust of 25 lbs. per horse power. As engines are now made weighing no more than 10 lbs. per horse power, it is clearly demonstrable that a machine on this principle could be constructed to lift itself, carrying some 15 lbs. per horse power over and above the weight of the engines. Even if not a practical form of machine for travelling through the air, it would be a most interesting experiment to try.

Finally, we come to that variety of aërial machine which has been adopted by most inventors and which seems to promise the most satisfactory results. I mean what is known as the *Aeroplane*. Sir Hiram Maxim brought this prominently forward many years ago, and both he and Professor Langley have proved theoretically that it is the most economical form of apparatus, that is to say, that a given weight can be supported with less engine power than by other methods.

Great progress had also been achieved in recent years in this line. Libienthal pointed out the greater efficiency of curved surfaces as compared to flat ones. Phillips and Hargraves experimented further with aërocurves. Considering how much more we know about the subject now than when Maxim first built his machine, it looks as though we might really hear of great results shortly from America or Australia.

Our present position is, then, a hopeful one. Balloons have been gradually improved until we can practically rely on building one to go 15 miles an hour, and probably more. Large flying machines, giving practical experience of their construction, have been built. Good sized models have flown well through the air. Gliding machines, balanced and controlled by human effort, have been maintained in the air for considerable periods, and have descended at very gradual angles. And, what is of the greatest importance, small engines, giving great power for their weight, have steadily improved year by year, leaving but little for us to desire in this respect.

All that we require, then, to attain practical flight, is to make a machine only slightly better than those already in existence. To accomplish this all that is required is a certain amount of skill, and a good deal of money.

There has often been a lot of wild speculation about what might happen when flying machines are introduced into everyday life, but it may be worth while considering for one moment what is likely to result, so as to judge whether the matter is one really demanding an effort to accomplish, whether, in fact, "the game is worth the candle."

Whatever the exact form the apparatus may take, we may assume that it will possess certain characteristics. The first of these is that it will travel *very fast*. There are several reasons for supposing this. Not only *must* it be able to stem ordinary light breezes, but to be really useful it should be capable of going against any ordinary wind, and to do this at any useful speed implies a rate of 40 or 50 miles an hour. Then, high speeds are economical in aërial machines. Langley, by his elaborate experiments, has shown that the faster our aëroplane is propelled through the air the less force in proportion is required to sustain it. Again, the air-ship, unlike its prototype on the water, is not impeded by skin friction, so that the power required to drive it at high speeds does not increase in the same proportion. A bullet can be propelled through the air at immense speed, but if it enters the water its way is soon stopped. One more reason why we may hope for greater speeds than are usual in travelling on land and sea is, that in the latter, pace must be kept within bounds for fear of collision, both with other conveyances and also with irregularities (whether in rails, embankments, and ridges, or rocks and sandbanks) which may exist beside the track.

In the aërial highway we have greater latitude. We have height as well as length and breadth. We can choose our particular altitude and stratum to travel in, so that perhaps 1,000 machines could cross over the same spot at the same time without colliding. In fact, it would decrease the chance of collision by one-thousand fold, in addition to the lateral route not being so circumscribed. There are no police traps up there!

Taking into consideration the speed at which birds travel, that at which models have been flown, and the theoretical calculations which have been made, we may reasbnably suppose that a hundred miles an hour will be no excessive speed for a flying machine.

Those who think this estimate over-sanguine may ponder over an extract I recently came across, from an old newspaper published 78 years ago, referring to the railway then about to be constructed from London to Woolwich. In this reference is made to the possibility of the train being able to attain the terrific speed of 18 to 20 miles an hour; but it concludes, with sarcastic incredulity, "We should as soon expect the people of Woolwich to be fired off on one of Congreve's rockets as to trust themselves to the mercy of such a machine going at such a rate."

Once a practical flying machine existed, the

Digitized by Google

uses to which it might be applied are varied and important.

Primarily, it would form an incalculably valuable engine of war. One can scarcely imagine any invention which could have a greater effect on the conduct of warfare.

We can now appreciate, much more than we could three years ago, of what vast importance such a machine would be. It is worth dreaming for a moment to realise what might have happened had we in 1899 had some machine capable of travelling rapidly through the air. First of all, for mere reconnoitring, how much could have been done! In Natal, on the outbreak of war, such a vessel, ascending at Ladysmith, could have cruised around up to Laing's Nek, noting every Boer and every gun within, say, five miles of the track passed over, taking a turn round along the frontier, and have been back to report within a few hours. We would then, at "one fell swoop," have had certain, reliable, and full information of what was doing, instead of going on mere rumours and the vague observations of a few scouts. Another machine at Orange River could have moved forward, noted the position of the enemy at Belmont, Modder River, and Magersfontein, could have gone into besieged Kimberley and heard their news, and could have run back to report to Lord Methuen. I need not repeat the many instances that occur to me of the extreme value of such an apparatus for reconnaissance. We might really say that *none* of those awkward reverses which we suffered in the early part of the war would have occurred had we known the exact whereabouts of the enemy. Latterly, how easily the evasive commanders could have been located and followed up. Reconnaissance by captive balloon may be considered dangerous, but an apparatus travelling 150 feet a second runs an infinitely smaller chance of being hit by projectiles. If the dropping of explosives on the heads of an enemy is not now considered "fair play" (though it is difficult to see why this should be less humane than throwing lyddite shells from a howitzer), yet there are many more uses to which the aërial fighter might be put.

He could blow up the railway lines and bridges, even if he had to descend to do so. He could cut all the telegraph wires in the country, and could set light to stores and do other damage. A machine soaring about over a town or camp occupied by the enemy would certainly have a very decided moral effect on him. Communication could be kept up with, and even, perhaps, a few stores introduced into a besieged place.

I need not go further into the possibilities of the future. The more we think the matter over the more can we realise the extraordinary effect such an innovation would produce in war. I do not think anyone would deny that, had we been in possession of such apparatus during the late war, the operations would have been so greatly facilitated that the campaign would have been ended in a comparatively short time, and that we should have been saved an expenditure of many millions of pounds.

Even in naval warfare, if such speeds as I have mentioned were possible, the aërial machine should prove of infinitely more value than a submarine or a torpedo boat. If the invention of the Brennan torpedo was considered worth £110,000, how much more would be the value of a dirigible aërial torpedo!

Another important purpose to which flying-machines could be applied would be for the exploration of unknown lands. With a rapidly-travelling apparatus, the North Pole could be reached in a few hours. From the north of Norway it is about 1300 miles to the Pole. It would then be almost possible to go there and back in 24 hours! When we think of the large sums which have been devoted to Arctic and Antarctic explorations, and remember that very possibly a tenth of this amount might produce a machine capable of thoroughly exploring both these regions in a few weeks, it seems really worth considering whether such money is not wasted. The trackless deserts of Asia and Africa could be traversed and re-traversed, the mysteries of Mecca and of Lassa laid at our feet.

But over and above these most important and far-reaching possibilities of aërial navigation, there is the likelihood of a revolution in our ordinary modes of travel by one infinitely more rapid, cheap, and convenient. I have already given my reason for supposing that such a means of travel would be rapid. There is also good reason for supposing it would be economical. No rails or permanent way need be laid on the billows of the clouds. No roads need be constructed or kept in order through the realms of blue. Even expensive harbours, dredged channels, lighthouses and beacons, need not be maintained by the owners of airships. Going from place to place "as the crow flies" shortens the route and adds to the economy. The *convenience* of the system is also evident. Already we are beginning to appreciate the value of the motor car going from door to door, instead of our having to get to the train at a fixed moment. But when we can order round our aërial motor to take us straight to our destination, passing equally well over land or water, towns or cornfields, independent of traffic and roads, then only shall we realise what real convenience of travel is.

Speed, economy, and convenience are big factors in a new mode of travel.

But there is one consideration, which I believe is greatly responsible for the tardiness with which this subject progresses. Perils and dangers loom before us as a skeleton contaminating and haunting our castle in the air. The mere idea of being poised high up in the sky, and of falling from the machine through thousands of feet to Mother Earth, is so terrible to contemplate. But the aëronaut of to-day soon gets accustomed to being at a giddy height, and without doubt the people of to-morrow will have no qualms. Imagine the feelings of the savage who for the first time sees an express train rush through a station at 60 miles an hour, banging and clattering with fiendish uproar,

shaking the very ground, and darting along at a speed incomparable to anything he has ever seen before. Would he trust himself to travel by that means? Though to flit through the air with the speed of a swallow may seem highly dangerous to our inexperienced minds, how often do we see a bird fall headlong to the ground?

What we see, then, looming in the future, more or less near, according to the energies of, and the encouragement we give to, those pushing the matter forward, is the introduction of a new invention forming an invaluable and all-powerful weapon of war, an important aid to science and the practical knowledge of our globe, and a speedy, economical, and pleasant mode of getting from place to place, such as will probably completely revolutionise our present methods of travel. Is this to be hastened and encouraged? If so, how can we help to further the cause? Like most matters in this world, what is most wanted is money. Many clever inventors and engineers are quite ready with their plans, but have not the means to complete them. We see millions of pounds spent on equipment for war. Hundreds of thousands devoted to the building of small warships. We see thousands subscribed for geographical exploration. But for the encouragement of that invention which may be paramount over all these, we see practically nothing devoted. When I say "practically nothing," I am not forgetful of a certain few who have devoted much to this cause. We do not forget the very generous donations which Mr. Alexander has given to this Society, nor the valuable time and energy which our worthy Secretary has devoted so gratuitously to further the objects of the Society. Others, too, are helping as best they can with limited time and money; but what we would like to see would be a real solid fund built up, such as would enable us to get really useful work done. Then I feel sure it would not be long before the British nation would owe a debt of gratitude to the Aëronautical Society of Great Britain. (Loud Applause.)

Contributions of Balloon Investigations to Meteorology.

By Dr. William Napier Shaw, F.R.S.

In bringing to the notice of this Society the obligations under which Meteorology has been placed by those who have ventured themselves into the upper air, or who have devised and carried out plans for the exploration of the upper regions with self-recording instruments, I do not propose to give an exhaustive view of the subject. To do so would require more leisure than the exigencies of a more or less laborious office allow; but no one who is interested in the progress of Meteorological Science can fail to form some estimate of the valuable results which have been already obtained by the organisers of researches in the upper air, nor to speculate upon the still more valuable results which further prosecution of such researches may be confidently expected to yield in the future. Such speculation as to the future is particularly natural to any one who has to deal with the Meteorology of various parts of the British Empire; for it must be admitted that if any Meteorologist were invited to take a map of the world and put his finger upon the spots where the investigation of the upper atmosphere would seem to be most interesting and most urgently demanded, he would point first of all, perhaps, to some part of the ocean as being free from the perplexing uncertainties attaching to land observations, and, if restricted to *terra firma*, he would select the Eastern shores of the North Atlantic Ocean, the nearest shores to that great atmospheric laboratory, the generating station of travelling depressions; to the peninsula of India, the home of the monsoons, the most characteristic of the settled phenomena of periodic atmospheric change; and to certain remote islets in the wide oceans for the investigations of the general laws of the interchange of air over the ocean surfaces.

But who should investigate the upper atmosphere over the sea if not the greatest maritime nation on the earth; and when at the same time that nation possesses the most western outposts of Europe on the shores of the North Atlantic Ocean, when it controls the Indian peninsula, and when the remote islets where observations are desirable also fly the Union Jack, there seems good reason to express surprise and possibly some other emotions that the British nation is at present contributing hardly anything to an investigation that is so actively pursued in France, in Germany, in America, in Russia, and in Austria under conditions of far less cogency than apply in our case.

It is true there are difficulties. I do not suggest that the open ocean or a remote islet is a suitable place for ballooning. Our own islands are small enough to present difficulties and even dangers. On that account and on others the investigation is expensive; and though the results may be scientific, to be quite frank, there is no guarantee that they will be of immediate public utility. But if you allow me without protest to tell you that the difficulties, whatever they are, are such as British enterprise and British pluck cannot overcome, and that the expenses are such as British poverty cannot

afford, I shall take your acquiescence merely as an example of undeserved tolerance that I do not think you would extend to one of our neighbours across the seas if he were so rash as to express the same opinion. In that case you would, I feel sure, wish to find other and more cogent reasons for our inaction in such a matter or take the alternative course more natural to a Society devoted to Aëronautics and demonstrate the contrary with appropriate vigour.

I am, however, wandering from my subject. I wish to say that I am intending to limit myself to-night to those aspects of the investigations which have struck me in the ordinary course of my work without making any very special study.

First, there are many things in meteorological records of which we can give no sufficient explanation. Let me give you an example. This slide shows the recorded phenomena during a thunderstorm on July 27, 1900. You will notice very curious variations in the barometer curve and associated rainfall and other changes. These changes probably represent a very turbulent state of the atmosphere with great vertical displacement of air. Balloon observations confirm the hypothesis of turbulence, but they have not given sufficient quantitative results to afford an adequate explanation. I will cite a description of a balloon voyage in a hail storm by Prof. John Wise, the well-known American aëronaut, on June 17, 1843, taken from "Blasius on Storms," p. 141, which gives a thrilling account of the turbulent motion experienced.

Such experiences are perhaps too hazardous to be intentionally repeated and the description is too general to go further than to indicate a possible relation between the turbulent state of the atmosphere above and the instrumental change at the surface.

My next example of general observation is a picture of the upper development of a cumulus cloud taken from the magnificent publication of the Aëronautical Society of Berlin.

Mr. Bacon could probably add many other examples of contributions to what I may call descriptive Meteorology from the favourable point of view above the lower clouds afforded by balloon voyages.

Among the subjects of observations with instruments in balloons the most conspicuous are the determination of the vertical distribution of temperature and humidity. Some results as to the general direction and force of winds have been obtained, and observations of solar radiation and of electrical potential difference have been undertaken occasionally, but not to the same extent as observations of temperature and humidity. Without following any particular order, I propose to group what I have to say under the following heads:—

(1) The British Association inquiries conducted by Welsh and subsequently by Glaisher;

(2) The observations of M. L. Teisserenc de Bort at Trappes;

(3) The German establishment at Berlin;

(4) Mr. Rotch's Observatory at Blue Hill—

and to add some other observations.

The British Association has taken up balloon investigations for meteorological purposes on at least two occasions—in 1852, when Mr. Welsh carried out four ascents for the Kew Observatory Committee of the Association in Green's Nassau balloon; in 1862 and 1863 when Mr. Glaisher made thirteen ascents for a special Committee of the Association in Coxwell's Mammoth Balloon. Last year the Association returned to its old enterprise and appointed a Committee to co-operate with the Royal Meteorological Society in the investigation of the upper air by means of kites.

Welsh's results are represented in four excellent plates included in the Philosophical Transactions of 1853. They show observations up to a height exceeding 22,000 feet and the corresponding temperature and humidity.

The instruments employed were a siphon barometer, two pairs of wet and dry bulb thermometers, one pair being provided with means of aspiration, for causing a continuous current of air to pass over the bulbs, the other pair free, and a Regnault's hygrometer. The purpose of the aspiration arrangements was to avoid or at least to diminish the effects of solar radiation upon the readings of the thermometers. The results are similar in general form to those obtained by later observers, of which I hope to show you some reproductions on the screen. The temperature differences are approximately:

$(72° - 10°) = 62$ for 19,400 feet.
$(68° - 15°) = 53$ for 19,000 feet.
$(60° - 27°) = 33$ for 12,500 feet.
$(50° - 2°) + 48$ for 22,500 feet.

The humidity results are peculiar in that they show as a rule very considerable divergence from saturation when the observations are taken in actual clouds. To this point I shall return later on.

Glaisher's results for his thirteen ascents are given in the Reports of the British Association for 1862 and 1863. His instruments were generally similar to Welsh's, but after breaking the aspirated thermometers he discarded the use of the aspirator and trusted to

Digitized by Google

polished metal screens for the protection of his thermometers against radiation. He also carried with him electrical and optical apparatus as well as ozone papers.

I give on the screen a general representation of his results for temperature, which have remained until quite recently the ultimate authority for the accepted numbers expressing the average vertical temperature gradient. From the slope of the curve you will see that the tendency is towards a limiting minimum temperature at heights within the reach of balloons.

The interval between Glaisher's observations and the more recent ones to which I shall allude is chiefly conspicuous for the development of portable self-recording apparatus. With purely mechanical multiplication very delicate aneroids, thermometers, and hair hygrometers, particularly by the well-known firm of Richard Frères, of Paris, are made to read the pressure, or height, the temperature, and humidity upon a revolving drum, and this instrumental development has given rise to extensive use of unmanned balloons and kites for meteorological purposes. The manned balloon is, of course, an indispensable adjunct as furnishing a means of comparing the indications of these self-recording instruments with the eye-readings of standard instruments similarly exposed; but I shall now turn your attention to results obtained by the other type of instrument, the self-recording, as distinguished from the eye-reading instruments used by Welsh and Glaisher.

M. Teisserenc de Bort's establishment at Trappes, near to Paris, is a laboratory of Atmospheric Physics on a large scale. Balloons of all kinds and kites of the highest lifting capacity are constantly employed in making observations.

The representative diagram from this observatory, which I shall shew you, gives the temperature of the air over Paris for a continuous period of six weeks in the early part of 1901.

By way of supplement to this I place before you a corresponding diagram of the hourly variation of temperature over Berlin from a series of ascents made at the aëronautical establishment there by the balloonkite, a monstrous instrument which is inflated with gas and yet keeps its equilibrium in a wind when it is held captive. For this I exhibit also a reproduction of the actual record showing the long duration of the ascent of the balloonkite.

I have introduced these diagrams as falling naturally into comparison with that by M. Teisserenc de Bort without any account of the institution that furnished them. But I now repair that omission by calling attention to some points in connection with it. It is a very fully equipped establishment upon the Tegler Schressplatz, near Berlin, and is, at the same time, the most active centre for the investigation of the upper air. Its best known aëronauts, Berson and Süring, have accomplished the most adventurous ascents in free balloons. Its unmanned balloons have reached the unexampled heights of upwards of 60,000 feet, while its balloonkite and its Hargrave kites are continually exploring the more accessible regions of the atmosphere.

Two years ago it contributed three magnificent volumes of results of the investigations carried out under its auspices entitled *Wissenschaftiche Luftschiff fahrten*, and recently it has published an additional volume of results of the more recent experiments. From these volumes I have already taken the illustration of the development of cloud above the first cloud layer and the diagrams representing the results of the kite balloon observations. I will now exhibit some additional diagrams taken from the same source.

The first shows the temperature results at Berlin compared with Glaisher's results, and the second, a comprehensive summary of the results of the Berlin observations for vertical temperature distribution at different seasons.

With regard to this question of temperature, it will be remembered that the inference from Glaisher's observations was that the temperature approached a limiting minimum at a comparatively moderate height. This conclusion was questioned by Berson and the other Berlin investigators, who found no indication of a slackening of the fall of temperature, indeed, rather the reverse; but on prosecuting the researches in still higher altitudes the indication re-appears. At the Aëronautical Congress at Berlin in May last, M. Teisserenc de Bort expressed the opinion (quoted from Mr. Rotch's report in the *Monthly Weather Review*) that in the layer between 8,000 and 9,000 metres (26,000 to 30,000 feet) the decrease of temperature becomes slower, ceasing entirely at 11,000 metres (36,000 feet); above that height a warming may set in with fluctuation of 1 to 3 C., making the temperature on the average nearly constant. In the summer this isothermal is higher between 13,000 and 14,000 metres, lower during the prevalence of depressions, but 4,000 metres higher during a high pressure. These results are confirmed by the more recent results observed at Berlin, from which it appears that

above 10,000 metres (33,000 feet) temperature oscillates and does not appear to decrease, although beyond the variable stratum at 17,000 metres (56,000 feet) and recently as high as 19,500 metres (65,000) feet), the temperature was again found to decrease so that the possibility of an absolute minimum of temperature is by no means excluded.

Among the services rendered by the Berlin establishment must be reckoned some important contributions to our knowledge of the conditions requisite for obtaining accurate meteorological measurements, particularly of temperature. The exposure to radiation in the upper atmosphere makes the observations of temperature particularly liable to error. A great step in advance is marked by the introduction of the convenient ventilation psychrometer the invention of Dr. Assman, the chief of the Berlin establishment, but accuracy in measurement requires not only suitable instruments but suitable mounting in, or rather outside, the car of the balloon to avoid the influence of the body of the balloon itself. Dr. Assman also claims our thanks for having introduced for the purpose of automatic reading a self-recording instrument for pressure and temperature without clockwork, which is a considerable item in the weight to be carried by an unmanned balloon. The motion of the drum, or rather disc, carrying the paper is actuated by the temperature changes, while the aneroid needle records on the disc the corresponding atmospheric pressure, and there is thus recorded a curve of direct relation between temperature and height without any time record. This arrangement reduces recording gear to the minimum weight, and it is used by Dr. Assman in conjunction with unmanned rubber balloons which are allowed to expand as they rise and ultimately burst, leaving the instruments to be carried down by a parachute. In this way enormous heights are comparatively easily attained.*

To the investigation of the behaviour of instruments the international simultaneous balloon ascents have largely contributed. These are held on the first Thursday in each month and ascents are generally undertaken with them at Paris, Berlin, Strasburg, Vienna, St. Petersburg, Blue Hill, U.S.A., and now in Italy. The ascents may be either of manned balloons, ballons-sondes, or kites, and for these ascents a special form of self-registering thermometer, introduced by M. Teisserenc de Bort, is prescribed. While in consequence of the difficulty of recording accurate temperatures in a floating balloon in sunshine it is suggested that ballon-sondes should be sent up an hour before sunrise.

I have incidentally mentioned Blue Hill. I ought to point out that the observatory under the direction of Mr. Rotch is largely responsible for the development of kite investigations. I give one of the earliest diagrams of kite records, which was published by that Observatory.

I have also much pleasure in placing upon the screen a reproduction of the records obtained when I was present on August 20th of this year from the deck of a steam tug near Crinan Harbour, off the west coast of Scotland, by Mr. Dines, in the course of the investigations to which I have already referred, as the third enterprise of the kind in which the British Association has taken part.

I now wish to return to the consideration of the measurements of humidity. This quantity is subject to very great irregularities of vertical distribution. As a general rule the percentage humidity of the air increases with height until the first cloud layer is reached; beyond that the air becomes dry, sometimes very dry, but humidity increases again to a second cloud layer and the process is occasionally repeated a third time, as illustrated by the Blue Hill diagram. When the apparatus passes into a cloud, saturation should be recorded by the instruments. In the earlier experiments this was not the case, as will be seen from the reference to Welsh's diagrams and Glaisher's tables. Glaisher also frequently speaks of the transition from dry fog to wet fog, but I think the dryness indicated in a cloud must be attributed to defective measurements of temperature, for any cloud, that is not merely of a transient character like the puffs of steam from an engine, must indicate saturation of the atmosphere. You will notice that saturation is indicated in the Blue Hill diagram where the kite passes into the clouds. In London it appears that we may really have dry fog, but fog in that case is a mixture of water particles with smoke and the products of combustion coat the globules of water and protect them from evaporation. In the clean air dry fogs cannot be accepted as reasonable. With kites the wire generally comes down loaded with condensed moisture when a cloud has been traversed. The registration of saturation when the balloon or kite passes into the clouds may be regarded, indeed, as a means of testing the instruments.

* As Dr. Shaw pointed out to the members during the reading of this paper, the idea of bringing the instruments to earth by means of a parachute was first devised by the Hon. Secretary of the Aeronautical Society of Great Britain.—Ed.

Digitized by Google

I will not detain you longer by considering the measurements of radiation and atmospheric electricity in balloon voyages; measurements of electrical potential especially have contributed most materially to the recent almost phenomenal development of a satisfactory basis of explanation of the electrical phenomena in the discovery of electrons or charged ions and their properties. And with regard to the winds I will only say that it is clear from such observations as have been made that the cyclonic storms and variable winds which are the most conspicuous feature of our experiences are confined to a comparatively low stratum of the atmosphere above which the atmospheric currents are persistent and regular. I do not think that more conclusive evidence of the difference of meteorological experience at different levels can be cited than the case quoted in the Berlin reports, where a manned balloon and an unmanned balloon started together from Berlin. The manned balloon, with a south-easterly wind, made its way to Jutland, whereas the unmanned balloon, rising eventually to a height exceeding 60,000 feet, found an upper current and descended in the Balkan Peninsula.

The PRESIDENT: There are one or two gentlemen present who I daresay would like to take part in the discussion on this paper. Perhaps Dr. Scott, whose name we all know, would like to say a few words.

Dr. SCOTT: I have very little to say on the subject. I have not myself been witnessing any of these experiments. That curve of humidity through a vertical stratum of clouds is very curiously supported by some records which are given in Herschell's meteorology. There is a letter from Dr. Dalton giving an account of Peak Teneriffe, and how the guides explained that there were certain points at which it was not safe to lie down to rest, because they got into certain humidity; and this is repeated in Herschell's Meteorology. I think there is one thing, if you will allow me to say so, with reference to the President's address. I have always understood that there was very great difficulty in managing balloons as to the precise amount of weight that was carried, and if you had anything like the weight that was mentioned, letting loose explosives, or anything of that kind, over a town, the balloon would immediately mount and get completely out of hand by the mere fact of altering the amount of weight in it.

The PRESIDENT: It is now my pleasant duty to propose a vote of thanks to the reader of the paper, Dr. Shaw. We have all heard a very interesting paper to-night on a subject which is of great interest to all connected with meteorology and the investigation of the upper atmosphere. Some of these diagrams which we have seen are of great interest. I don't think it is necessary for me to make any criticisms on the paper. I only wish we could have heard some more remarks from those who have had experience in the matter of investigation. Unfortunately Mr. Dines has gone, and I do not know whether there is anyone else here who has taken the subject up. I will only ask you now to record your thanks to Dr. Shaw for his paper. (Applause.)

Sir HIRAM MAXIM: Ladies and Gentlemen.—If anyone is entitled to a vote of thanks here to-night, I think it is our old friend the President, Major Baden-Powell. (Cheers.) Certainly he has stuck to the thing with a great deal of enthusiasm, and after a long period of study I think he has learnt a great many new truths in connection with the subject that we all have nearest our hearts. I agree with him fully that the apparatus would be of enormous value to the Empire—if we had it. It is well known that it is within our reach, that the material is at hand to make it all, that the engines have already been developed to a sufficiently high degree of efficiency to make a flying machine; but it requires an enormous amount of money. In the experiments I made I spent fully £20,000. I should say, however, at the present moment if we had £100,000, and with such a clever engineer as Major Baden-Powell to conduct the experiments, that the Empire might possibly have a practical flying machine inside two years. I do not believe, however, that we shall use them for taking coals to Newcastle, I do not believe they will be used for the purposes of the Parcels Post, but rather for reconnoitring in time of war. They look to me as though they would be dangerous playthings at the best. During the last six months I have been troubled with bronchitis, and I am told by my physicians that I must get out of London any way, and, perhaps, out of England; and it has occurred to me that I might possibly get over my sore throat if I went back to my native country for a year or two, that is to the United States of America. And it is quite possible that I shall leave England and go to America, and while there I may conduct some experiments. It would be a very easy matter to get a large and level piece of ground in the State of Connecticut, or I might get an equally good place on Long Island. So I should not be surprised if, when you don't hear from me, I should be somewhere else, otherwise I am going to the States and may make some experiments on flying machines

and perhaps be back in two years. So I hope you will all join me in a vote of thanks to our very able President. (Applause.)

Mr. E. P. Frost: Ladies and Gentlemen,—It requires a very few words from myself at this late hour to support such an excellent proposal as Sir Hiram Maxim's vote of thanks to our Chairman, Major Baden-Powell. We are very pleased indeed to see him back amongst us again, and safe and sound, and it is my pleasure at this moment to second the vote of thanks proposed by Sir Hiram Maxim.

The Chairman: Well, Ladies and Gentlemen,—I need hardly say how thankful I am to you for the way in which you have received this vote, and I will not detain you much longer with any words from myself. I omitted to refer to Dr. Scott's remarks about dropping explosives from a balloon. I think he is quite right. I should be very sorry myself to go up in a balloon and drop any large quantity of explosive, because the balloon would ascend to a great height. I am almost sorry, I might say, to hear Sir Hiram Maxim talk of going away from England, because, of course, if he is going to make any experiments, we should like to know they were made in England and be there to see them. If he does go, we shall all wish him *bon voyage*, and we shall hope he will come back in his flying machine across the Atlantic. (Cheers.)

The proceedings then terminated.

The Cycala Flying Machine.

By Dr. Charles Zimmerman.

In my last communication to the Society it was stated that I had means by which I could vibrate my thirty-five-foot expanse of wing machine, that if it did not go, "I would try again." Well, it didn't go. Now, some one may say, "that was to be expected;" however, we can say, in rebuttal, that if hope did not burn brightly in the average inventor's breast, or his energy would fag in the effort to produce in material form his conception, or the unsympathetic attitude of his too conservative, yet esteemed contemporaries would cause him to desist, we would have no improvements, and progress would cease, except, perhaps, in the old beaten paths. It is far easier and much more pleasant to record and report success than failure. It is said that success is often the result of failure, but in the pursuit of the *ignis fatuus* of aëronautics, failure has been broadly written across all effort to wrest from the air that necessary grip and traction which will give us suspension and propulsion as does a marine vessel in water or an automobile on land.

The photographs herewith reproduced were taken by an amateur, and are rather deficient in detail; however, they will convey some idea of the general appearance of my machine. It consisted of a frame balanced on a bicycle wheel, and a wing, hinged near its middle on each end of the frame (Fig. 1). No tail was employed, dependence for longitudinal equilibrium was placed in the construction of wings, which will presently be described.

The frame to which the wings were hinged was three feet wide, *i.e.*, fore and aft, and 16 feet from side to side, the outer ends tapered to a point, and were elevated about four feet above the ground. The wings were each 16 feet by 7½ feet, pivoted by a universal joint near their middle on the tip ends of body frame, so that the operator sitting astride the wheel could vibrate the wings up and down, or move them back and forth, each wing independent of the other. In practice, however, it was found that we could not move the inner end of wings more than about three feet up and down on account of their striking the body frame near the wheel, whereas it was calculated to vibrate them at least six feet. The next difficulty was due to the wing construction, this consisted of ordinary unbleached sheeting reinforced by ribs of bamboo, a loop was secured to each rib about one-fifth the width of wing from front or leading edge, through these loops passed the arm; this arrangement permitted each rib to independently rotate vertically on the arm, as well as gave us a flexible wing in every direction. It was found that the wind striking the surface in front of the arm, just balanced that which impinged against the hinder part; we also got an equal lift all along the arm, no matter what its length. The body frame was hinged to the arm of wing, and in this manner the operator was suspended below the centre of pressure or support, which would automatically accommodate itself to the varying air pressure and currents, obviating the use of a tail for longitudinal equilibrium. It was these considerations which led me to try a construction of this kind, notwithstanding I was predisposed to a machine without moving parts. The balanced rib would rotate on the arm and the back end strike the ground, effectually preventing vibration as intended, except in a wind, when the wings were almost horizontal, in which case I could vibrate them sufficiently to

advance slowly into the breeze. I soon saw this was not the machine I wanted, as my ideal must go whether the wind is on or not. After several trials I finally detached one wing and anchored it as a kite as shown in photograph (Fig. 2). The wind at this time was about 20 miles per hour, and the operator is seen lifted, by being suspended from the arm, the outer rib is bent under wind pressure due to a cord to hold it steady. In another case the operator coasted down hill against a stiff breeze in which the ribs assumed approximately a horizontal position, and seemed to adjust themselves to the wind as was theoretically supposed. The experiments, as a whole, were disappointing; but we have gleaned a little from them, and will, as has been said, try again. The suggestions here offered may be of some benefit to others, and here, I may say that I am greatly indebted to my contemporaries and to those who have passed beyond the stage of action for their recorded experiments and observations, and as my experiences have been somewhat at variance in minor details, I will record one or two instances together with expectations. It would seem as though the supporting surface could be arranged to brace the framing, so that no wires, braces, etc., would be in evidence. I have long contemplated constructing an exaggerated form of concavo-convex surface; a deep concave will inhibit more air than a shallow one. The lift should far exceed the drift, and the deeper the concave, in proportion to its width, the more apparent this becomes. How would a concave three or four feet deep in a surface 10 to 12 feet wide, tapering to a plane at tail and wing tips, do? But how are we going to get it light in weight, smooth, strong and effective, and into shape that experiments can be satisfactorily instituted? This will be my next endeavour, and I think the first flyer will be motorless, the latter will be an adjunct after man-flight is a fact. In reference to superposed and following surfaces, if a slip of cardboard, say 3 by 12 inches is slowly vibrated back and forth in a still room in which smoke from a cigar is floating, it will be seen that the air is decidedly affected above and below, behind and before, several times the width of the cardboard, more so above and behind, than in front and below. This would seem to preclude any surface save only a single one-pair of wing machine.



The Cycala Flying Machine. (Fig. 1.)

In flying as a kite, the following surface is always depressed, when, as the single narrow wing sails approximately horizontal. In falling from an elevation the single surface sails twice as far as the double deckers or following surface models.

In reference to the concavo-convex wing surface, I am persuaded that the tendency for this shape to dip in front promotes propulsion, the flying body is balanced on a rolling trans-

Digitized by Google

verse column of air, and the least forward or backward movement of centre of support causes the body to tilt forward or backward, the forward motion prevents the back tilt to become more effective than to elevate the body. Propulsion here seems to be a state of unstable equilibrium. If this process can be controlled in a single pair of concavo-convex bird-shaped wings, our problem will be much simplified.

Many writers assert that the down stroke of a bird's wing is more rapid than the up stroke; and a bird, to elevate itself, beats its wings downwards. From my own observations carried on for a number of years, and after watching them closely and intently, it would seem that the wings are always positively inclined to plane of motion; this means that when a bird elevates itself by flapping its wings at an angle of say 80° with the horizon, that the plane of the wing is almost vertical and the wing-beats are horizontal. In flying horizontally the wind-beat is in direction from up and back to down and forward—that the down-beat occupies almost twice the time as does the up-beat—during the down-stroke the bird's body rises, and during the up-stroke it falls. It would seem as though wing and bird were united by a very elastic medium, and that the bird's body was constantly springing up and down, forcing the wings to always move in the contrary direction.

If an open umbrella is rapidly pushed up, the inrushing air at the end of the stroke will tend to carry it further up; if it is then slowly pulled down there will be a comparatively small depression on top of the same, due to the down rush of air at end of stroke. If these motions are reversed it will develop a most decided depression at the end of down-stroke. The inference in reference to bird-flight is apparent; the convex top at the end of a *slow* down-stroke cannot produce a depression equal to the concave bottom at the end of a rapid up-stroke which elevates.

If an open umbrella is held horizontally in a brisk breeze and a small column of smoke is



The Cycala Flying Machine. (Fig. 2.)

Digitized by Google

injected beneath, the smoke will rotate the whole width of umbrella in a direction similar to that of a wheel on the ground; this would indicate that the rolling transverse column of air referred to above is put in motion by the wing construction, and the upper half of this air is moving forward, incidentally pushing the surface forward. There are details of construction which I am prevented making public on account of being subjects for patents. There are pirates abroad waiting and watching, as soon as something is produced, they will appropriate it, and the inventor and investigator will never be known, much less rewarded, unless he first secures protection as far as possible. In this I am at variance with some. However, I think we can recall, if need be, recent instances in this connection.

At the present time the majority seem inclined to the combination of aëroplane and balloon as the final solution of the flying problem; we think, however, that if the various motors designed to push a gas-inflated envelope through the air were applied to simple aëroplane contrivances, we would much sooner arrive at a definite understanding of the matter.

In conclusion, we would say that no one as yet appears to be flying, and we seem to be as near it as any; and further, we see no reason why we should abandon our line of research, we will, therefore, endeavour to go a little further. Let our machine be an aërocurve with a pair of wings at an angle with tips up, a bird-shaped body, the latter to shield operator from head wind, and transform into lift what would otherwise be drift. The front edge of wings to be rigid compared with the back edge, yet the whole to be flexible so that a puff of wind on the side will have no more effect than to lift a portion of the wing without disturbing the whole system, the whole to be complete without moving parts; this includes the operator, who becomes an integral part, the life or motor of the machine—such a machine will depend for equilibrium and stability on its inherent flexibility and elasticity. The operator rocking transversely or back and forth, or springing up and down, should be able to propel it in a calm, and in a wind we should have sufficient power to transport ourself in any direction. Apply a motor to a construction of this nature and our conclusions would be much nearer being realised in a *bonâ fide* flying machine than with a stiff, rigid and unyielding apparatus for which we can find no counterpart in nature.

NOTES.

Message Balloons in Polar Expeditions.—The *Daily Chronicle* in September last gave an interesting account of the interview of Reuter's representative with Mr. Evelyn B. Baldwin, the leader of the Baldwin-Ziegler Polar Expedition, which has returned to Norway after 15 months' work in the North Polar seas. During the expedition fifteen pilot balloons were despatched, by means of which three hundred messages were distributed. To each of these balloons was attached a string of buoys which, by means of automatic contrivances, were released as they touched ice, land, or water. As the prevailing winds were north-easterly, it is likely that these balloons were driven on to the great ice field which last year blocked up the entire eastern coast of Spitzbergen to such an extent that no vessels were able to navigate, during the entire summer, the western waters of the Barents Sea. It is expected that as the ice drifts southwards along the eastern coast of Spitzbergen the buoys will be released, and when found will furnish valuable testimony concerning both air and sea currents. Every buoy is numbered, and contains a detail record of all conditions prevailing at the time of its being sent off. Every buoy is addressed to the nearest American consul, who will duly advise Mr. Baldwin of its discovery.

The International Balloon Ascents.—During April, May, and June last, twenty-one balloon ascents were made. France, Germany, Russia, and Austro-Hungary taking part in the experiments. The greatest height attained by the balloon-sondes was shown by the record of the balloon sent up from Berlin on May 1, when 19,564 metres were reached. The temperature on the ground was 6°·8; lowest reading during ascent, 58°·5. The next highest ascent is also recorded from Berlin, on June 5, when 16,750 metres were reached. Temperature on the ground, 18°·4; lowest reading, 58°·5. Next to this came the balloon sent up from Vienna the same day, when 10,480 metres were reached. Temperature on the ground, 15°; lowest reading, 62°·8.

The Fatal Accident to M. de Bradsky.—On October 13 last, M. de Bradsky and his engineer, M. Morin, perished in the Bradsky airship at Stains, near Paris, the ascent having

Digitized by Google

taken place at Vaugirard. The Bradsky air-ship was a cigar-shaped balloon 36 metres long and 6 metres in diameter, and had a cubic feet capacity of 850 metres. The airship was designed so that the balloon, the framework, and the passengers should be exactly equal to the ascensional power of the airship, the ascending power being furnished by means of a vertical propeller placed under the framework. On the fatal day, however, it appears that this balance was not perfectly attained, and that the airship had ascensional power from its hydrogen, apart from the action of the vertical screw. The framework was 22 m., 50 c.m. in length. It was constructed of steel tubes, and supported a car 5 m. long. It was suspended 3 m. 50 c.m. below the cover of the airship, and carried a petroleum motor of 16-horse power. At the back of the frame was the screw, which made 350 revolutions per minute. The rudder had 4½ square metres of surface.

Perhaps one of the most accurate descriptions of the ascent and consequent tragedy was that given by M. Aimé, and which appeared in the *New York Herald*, on October 14th. The balloon is described as starting off majestically under the joint lifting power of the hydrogen and the vertical propeller. It hovered for a minute or two over the Balloon Park of Vaugirard, and drifted little by little under the influence of the wind towards the Camp de Mars, the Invalides, the Place de la Concorde, and the Avenue de l'Opera. "As the air-ship advanced slowly up an altitude of two hundred metres, turning round and round as it went, sometimes advancing, sometimes moving backwards, swinging to port and starboard, in spite of the rudder, of which M. Morin held the tiller, and in spite of its propelling screw, under the direction of M. de Bradsky, it was only too easy for the spectators to perceive that it was drifting at the mercy of the wind. In reality, though the air-ship obeyed neither its rudder nor its propelling screw, it obeyed only too well the disastrous action of its ascensional screw, the perturbing influence of which would have sufficed to paralyse the effect both of the propelling screw and the rudder, even if the motor had been strong enough to resist the light breeze from the south west. The ascensional screw turning vertically under the car at the rate of five hundred revolutions a minute, made the air-ship swing round at the rate of about one turn per minute. Under these circumstances, the propelling screw and the rudder were powerless."

In M. Aimé's opinion what was necessary was a second screw turning in the contrary direction to neutralise this tendency to rotation.

On account of this rotation came the disaster, as M. Aimé points out from the Palace de l'Opera. It was plainly visible that under the influence of the vertical propellers the axis of the balloon obliged to turn by the resistance of the air ceased to be parallel to the axis of the car, and that in consequence the steel wires which fastened the car to the balloon underwent a tension which they could not withstand, breaking one after the other, with the fearful result that the framework parted from the ballon and fell to earth with the victims of the experiments.

The accident emphasises the necessity of more careful preliminary experimental work in designing novel aërial machinery. The action of the vertical screw on the balloon should, no doubt, have been first tested in mid-air by means of a balloon carrying no passenger. The twisting effect could then have been observed and corrected on a second experiment.

The Air-ship of the Brothers Lebaudy.—On November 13th, just one month after the disaster described above, the "Jaune," the navigable balloon of the brothers Lebaudy, made several successful return journeys in a calm atmosphere, though it is doubtful whether any advance was made in those journeys on the work of previous experimenters. The balloon is about double the size of that of M. Santos-Dumont, and carries a petroleum engine of 40 horse power. The length of the air-ship is 56 metres, 50, and it has a gas capacity of 2,284 cubic metres. The platform, constructed of bicycle tubing and steel piano wire, is 4 m. 80 long, and will accommodate three passengers. The two propellers are 2 m. 80 in diameter, and are placed at the side of the car.

Balloon Clubs.—It has lately been stated in public that the present Aëro Club was the first institution in this country to organise club balloon ascents. This is an error. Years ago there existed the Balloon Committee, established for the very same purpose for which the Aëro Club exists to-day. It comprised several famous amateur aëronauts, including Sir Claude de Crespigny, Sir Henry de Bathe, Colonel Templer, the late Mr. Powell, and the late General Brine, all of whom were ardent balloonists in the cause of pleasure and sport. Therefore, this country, years ago, set the example in the formation of balloon clubs, as it did in the formation of aëronautical societies. By all means let the rising generation have their ballon clubs, but in

their historical allusions let them not forget those who have piloted the way before them.

Aërography in Berlin.—Dr. Assman, of Berlin, contributes to the *Aeronautical Journal* the interesting and valuable information that for some months past the daily news from the higher atmosphere collected from kite observations appear in the *Reichsan-Zeiger* and several other leading papers. Up to now this has been done in no other place in the world except Berlin. Dr. Assman urges the importance of this work being also carried out in the British Isles where there are special advantages of frequent strong winds from our insular position.

The Exhibition of Balloon Photography.—In mentioning the excellent exhibits of balloon photography exhibited by the Rev. J. M. Bacon, to the recent Exhibition of the Royal Photographic Society, the Rev. F. C. Lambert makes a valuable and useful criticism on the arrangement of such aërial photographs at exhibitions. He points out that to get anything like the true and faithful reproduction of the original effect the picture should be so placed that it is looked down upon and not hung upon a vertical wall. At the Royal Photographic Society's Exhibition only in one case did the hangman think fit to comply with this important consideration.

REVIEWS.

The Greatest Flying Creature.

By S. P. Langley.

Reviewed by Major B. F. S. Baden-Powell.

The Greatest Flying Creature: by S. P. Langley introducing a paper on the Pterodactyl Ornithostoma, by F. A. Lucas, is a short, well-illustrated pamphlet dealing with this ancient and gigantic flying creature and its relation to modern birds and flying machines. From the fossil remains much has been learnt. The wing was evidently formed of a membrane stretched on the bones of the forelimb very like that of the modern bat. The beak was extremely large and sharp, probably with a small pouch like that of a cormorant. From many evidences it is concluded that it lived entirely on a fish diet, and that it flew long distances out to sea.

The comparatively small size of the breast bone, and, therefore, presumably of the thoracic muscles, would imply that it soared after the manner of an albatross rather than that it did much flapping of its huge wings. Actual measurements indicate a spread of wing of 20 feet. But it is supposed that its weight was not so great as might be conjectured for this expanse of wing. Mr. Lucas, estimating from a variety of considerations, puts it at under 30 lbs.

Some interesting tables are given to compare the supposed proportions of this animal with those of various existing birds, and also with Langley's model aërodrome. These show how, roughly speaking, the horse-power decreases proportionately to the size of the animal's weight and wing surface, that of the artificial model showing an enormously large proportion. Prof. Langley does not discuss at any length the inferences which may be drawn from this comparison. And if it be true that the weight of this creature was no more than that of some existing birds capable of flight, no very important lessons are to be learnt.

The Illustrated Scientific News.

Horace Marshall and Sons, London.

The latest attempt for the popularisation of science generally is the *Illustrated Scientific News*, the first number of which appeared in October last and which is to be published monthly. It ranges over a wide field, and from its variety should enlist the interest and support of the public. The opening numbers have been excellent throughout, both as regards the letterpress and the abundant illustrations. There is not a single page without interest to the general reader. Amongst the special articles which have already appeared is one by Major B. Baden-Powell, on the De Bradsky air-ship. The portraits of scientific celebrities which appear monthly are a feature of the new enterprise, and the January number contains the portrait of Sir William Crookes, F.R.S., the illustrious member of the Council of the Aëronautical Society of Great Britain.

The Dominion of the Air.

By the Rev. J. M. Bacon.—Cassell and Co., London.

The frequent accounts of aëronautical experiments which have lately appeared in the daily and weekly Press have done much to enlist general interest in aërial matters. Many of the public, however, have begun to want to know more about the problem of the mastery of the air than can be learnt in isolated articles. To such, "The Dominion of the Air," written by one who has often braved its perils, will

Digitized by Google

appeal. The book may be described as a popular history of aëronautics from the earliest efforts of Bacon and the Jesuit Lana, to the numerous performances of modern so-called navigable balloons. So graphically and pleasantly does Mr. Bacon treat the subject that the book before us can be read through on a railway journey of a few hours with the ease of a novel, and yet the reader will have imbibed a fund of information on the subject which he, perhaps, never possessed before.

We can confidently recommend this book to those who wish to obtain some entrance into aëronautical doings. The descriptions as a whole appear to be fairly accurate, which cannot be said of all books which claim to treat of popular science.

One error, however, must be noted. In chapter xxvii., speaking of the possibilities of balloons in warfare, the author remarks that these are now made of fragile material, and from the context it is presumed that the author means the British war balloons. The epithet fragile, however, cannot be justly applied to the envelope of the balloons manufactured at Aldershot by the Government. True the material—gold-beater's skin—in itself is fragile, but as several layers of gold-beater's skin are used in the construction of the war balloons the result is strength in the balloon envelope which in practice has been found to stand the wear and tear of military operations most admirably.

The illustrations in Mr. Bacon's book are abundant and well-selected.

Foreign Aëronautical Periodicals.

(In this list a selection of some of the more notable articles is given.)

L'AÉRONAUTE (Paris).

October, 1902.—Projet de ballon automobile (M. Josselin).

November.—Projet de ballon automobile (suite).

L'AÉROPHILE (Paris).

November, 1902.—Portraits d'Aéronautes contemporains: Henri Julliot (Edward Surcouf); L'Aéronat des Frères Lebaudy (Georges Besançon); La forme du ballon dirigeable (Jules Carelli); Croisières Aériennes (Henri Gaspard).

L'Aéronautique.—(No. 3, 1902). Ascension du ballon le Rêve bleu.

ILLUSTRIRTE AËRONAUTISCHE MITTHEILUNGEN (Strassburg).

October, 1902.—Uben den Zuschnitt von Ballonhullen (Prof. S. Finsterwalder in München); Luftballons, welche längere Zeit die nöthige Tragfähigkeit beibehalten können (Eric Unge); Die Freifahrt des Ballons "Schwede" am 29, 30 Juli, 1902 Die Gondelversuche im Wasser und der Unfall des Ballons Svenske (W. L. Moedebeck); Elektronen-Aspirationsapparat (Dr. Hermann Ebert); Ein Modellflieger nach Kress'scher Art (Arnold Samuelson).

WIENER LUFTSCHIFFER-ZEITUNG.

October, 1902.—Grundzuge der Praktischen Luftschiffahrt (Victor Silberer, VII. Die Langlung); Zur Explosion des "Svenske" (Gustave Trouvé).

December.—Grundzuge der Praktischen Luftschiffahrt (Victor Silberer, VIII. Die Schleifung); Graf Castillon de Saint-Victor; Der neue Kress'sche Drachenflieger; Der Ballon der Bruder Lebaudy; Zur Katastrophe des Bradsky.

Notable Articles.

Oct. 1902.

4. *The Sphere*.—"Some of the Latest Flying Machines."
14. *Lancashire Daily Post*.—"The Airship at Blackpool."
15. *Daily Telegraph*.—"Airship Disaster: Some Expert Opinions."
— *East Anglian Times*.—"Travelling in Mid Air," lecture by Mr. Eric Stuart Bruce.
21. *Daily News*.—"Santos Dumont's New Airship."
23. *New York Herald*.—"Two Experts on Ballooning Trials."

Nov. — *L'Humanité Nouvelle*.—"La Navigation Aérienne."

12. *Times*.—"Mr. Bacon's Aëronautic Experiments."
— *Daily Chronicle*.—"Sea Trip by Balloon."
15. *Illustrated Mail*.—"115 Miles in a Sea of Fog."
17. *Morning Leader*.—"Balloon Chase."

Dec. 6. *The Illustrated London News*.—"A Rival to the Balloon: The Kite in Warfare."
— *Daily Graphic*.—"To Conquer the Air."—Sir Hiram Maxim's Views.

Digitized by Google

Applications for Patents.

(*Made in October, November, and December*).

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33, Cannon Street, London, E.C.

20642. September 22. GEORGE WILHELM MAY. **A New or Improved Aerial Ship.**

20973. September 26. JOSEPH YATES. **Aerial Motor Car.**

21363. October 1. HERBERT JAMES OWERS. **A Combination of Rudder and Propeller for Propelling Air-Ship or Boat.**

21500. October 3. ROBERT WALTER HUTTON. **An Improved Toy Air-Ship or Flying Machine.**

21535. October 3. CHARLES CADET. **An Improved Air-Ship.**

21680. October 6. HENRY MIDDLETON. **Improvements in Balloon Flying Machines or Helicoptera Aerodromes and Aeroplenets.**

22041. October 10. ADA MCDONALD. **Improvements in Machines for Navigating the Air.**

22123. October 11. FRANCIS ALEXANDER BARTON AND ANOTHER. **An Automatic Equilibrium Device for Air-Ships and the like.**

24733. October 18. SAMUEL FRANKLIN CODY. **Improvements in and connected with the Methods of and Apparatus for controlling the Travel of Carrier Kites.**

23713. October 30. HERMANN MUSCHEN. **Improved Driving Apparatus for Air and Water Vehicles.**

24336. November 6. LORD HOWARD DE WALDEN AND ANOTHER. **Improvements relating to Mechanically Propelled Aerial Vehicles.**

25723. November 22. CHARLES GOOMBRIDGE AND ANOTHER. **Improvements in Propellers for Aerial and Nautical Purposes.**

25934. November 25. HENRI ALPHONSE HERVÉ. **Improvements in Captive Balloons.**

26135. November 27. JOSEPH BARCLAY. **A Flying Machine.**

26225. November 25. EUGENE LINCOLN SWINGLE. **Improvements in Aeronautic Apparatuses or Flying Machines.**

26582. December 2. ALFRED CHIODERA. **Improvements in and Relating to Air Balloons.**

26832. December 5. SABATINO DI LAURO. **Airship.**

26893. December 5. FREDERICK HENTSCHEL. **Aerial Carriage.**

27027. December 8. WILLIAM COCHRANE. **An Improved Flying Machine.**

28155. December 20. CELESTE JOLY. **Improvements in and connected with Flying Machines and the like.**

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MIC
AUG 4 191

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain
By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 27. JULY, 1903. VOL. VII.

All Rights Reserved.]

Contents.

PAGE.

NOTICES OF THE AËRONAUTICAL SOCIETY 45

THE ST. LOUIS AIRSHIP CONTESTS 45

GENERAL MEETING OF JUNE 25th, 1903—

1. "THE INTERNATIONAL KITE COMPETITION" *(Illustrated)*.. .. 47
2. "AËRONAUTICAL EXHIBITION" 48

THE WIND FORCES OVERCOME IN THE EXPERIMENTS OF M. SANTOS DUMONT WITH HIS NAVIGABLE BALLOONS IN PARIS, 1901 *(with Charts)*. BY A MEMBER OF THE PARIS AËRO-CLUB 49

EXPERIMENTS RELATIVE TO EQUILIBRIUM AND ANGLE OF FALL IN GLIDING FLIGHT *(with Diagrams)*. BY MAJOR L. S. BLACKDEN 53

MESSRS. GROOMBRIDGE AND SOUTH'S EXHIBITION OF AËRONAUTICAL APPARATUS 61

APPLICATIONS FOR PATENTS 62

LONDON:
PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

Digitized by Google

. . THE . .

Illustrated Scientific News,

A MONTHLY JOURNAL OF POPULAR SCIENCE.

PRICE 6D., OR 7S. ANNUALLY.

Contributed to by many of the Leading Scientific Authorities of the Day.

The Aëronautical portion being contributed by Sir Hiram Maxim, Major Baden-Powell, and Mr. Eric Stuart Bruce, M.A.

To be had of all Booksellers and Newsagents,
OR OF **KING, SELL & OLDING, Ltd., Lonsdale Chambers, 27, Chancery Lane, London, W.C.**

WANTED. . .

Two Copies of No. 9

OF THE

AËRONAUTICAL JOURNAL

2s. will be paid for each Number.

Apply, KING, SELL & OLDING, Ltd.,
LONSDALE CHAMBERS,
27, CHANCERY LANE, LONDON, W.C.

BACK NUMBERS

— OF THE —

AËRONAUTICAL JOURNAL

Can be obtained from the Publishers:

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, CHANCERY LANE, LONDON, W.C.

Digitized by Google

THE AËRONAUTICAL JOURNAL.

JULY, 1903.

The Aëronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

53, Victoria Street,
Westminster, London, S.W.

NOTICES OF The Aëronautical Society.

At a meeting of the Council of the Aëronautical Society of Great Britain held at the Stanhoe Hotel, Worthing (the headquarters of the Society during the International Kite Competition held at Findon), on June 24th, 1903, the following gentlemen were elected members of the Society:—

CAPTAIN JOHN BOSTROEM,
Naval Attaché to the Imperial Russian Embassy.

CHARLES WILLIAM BECKMANN.

COLONEL J. E. CAPPER.

MR. S. F. CODY.

MR. WILLIAM GREEN.

THE ST. LOUIS AIRSHIP CONTESTS.

A communication has been received by the Council of the Aëronautical Society of Great Britain from Mr. Octave Chanute, M. Aër. Soc., and Honorary Commissioner for the St. Louis Exposition, in which the suggestions of the Aëronautical Society of Great Britain are invited concerning the published rules of the aëronautical contests to be held in connection with the St. Louis Exposition in 1904.

The Council of the Aëronautical Society of Great Britain have decided to hold a council meeting to consider Mr. Octave Chanute's communication. Meanwhile, any member of the Aëronautical Society who has any suggestion to make is requested to forward same to the Honorary Secretary of the Aëronautical Society of Great Britain, 53, Victoria Street, Westminster, London, S.W., as soon as possible.

The rules will be found in the October (1902) number of the Aëronautical Journal.

In answer to enquiries, the Hon. Secretary begs to state that the newly-formed Aëronautical Institute and Club is in no way connected with the Aëronautical Society of Great Britain.

ERIC STUART BRUCE,
Honorary Secretary.

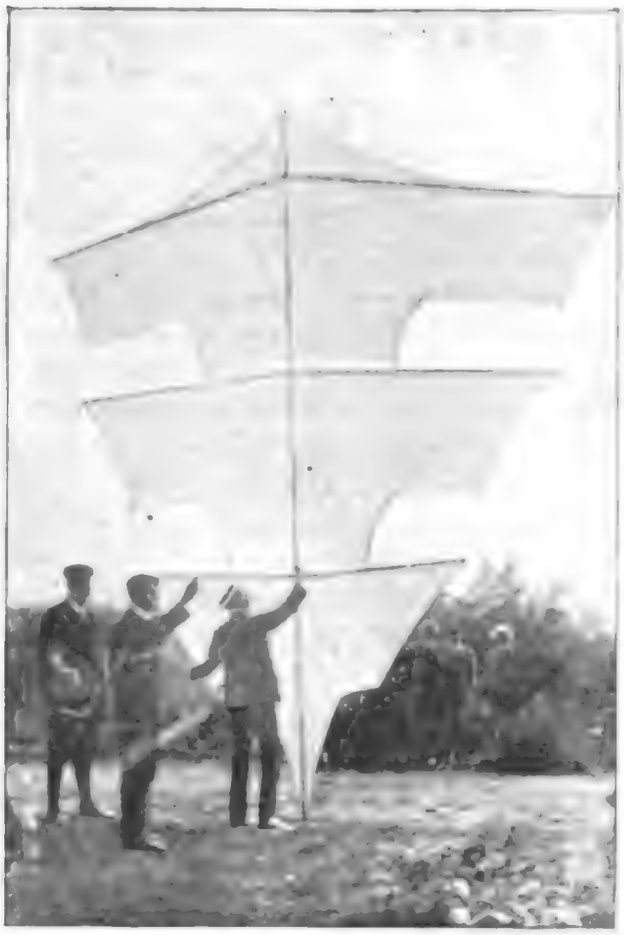
GENERAL MEETING.

The concluding meeting of the thirty-eighth session of the Aëronautical Society of Great Britain was held on the Sussex Downs, near Findon, by kind permission of Lord Henry Thynne, on Thursday, June 25th, 1904, at 2.30 p.m., to witness the International Kite Competition for the silver medal of the Society.

The proceedings of this meeting commenced on the evening of Wednesday, June

24th, when the Council of the Aëronautical Society of Great Britain and the Jury of the Competition and several members of the Society met at the Stanhoe Hotel, Worthing, which was the headquarters of the Society on the occasion of their visit. The Council and the Jury dined together, and later in the evening there were meetings both of the Council and of the Jury.

Early next morning a special brake conveyed Council, Jury, and Engineers to the scene of the first International Kite Competition that has been held. Here there was erected a spacious marquee for the convenience of members of the Society, in which



Mr. Charles Brogden's Kite.

refreshments could be obtained, and where there was an exhibition of objects of aëronautical interest.

This spot was selected for the aërial contest after months of search for the fittest place. In view of the extraordinary interest which has been aroused in kite flying by the efforts of the Aëronautical Society of Great Britain, it is as well to point out that, in the opinion of the Council of the Society, kite competitions in the neighbourhood of large cities might become a source of danger to life and property. They should take place in isolated spots, as far as possible from roads and railways.

At the International Kite Competition there were over one thousand persons present, amongst them being the representatives of the Russian, Austro-Hungarian, and German Governments. The full report of the proceedings is reserved for the opening meeting of the new session, when it will be read to the members of the Society, and subsequently published in the January number of this JOURNAL. It will now suffice to reprint from the programme certain details of the arrangements, and of the exhibition, and to announce the result.

The competition was for the highest flight attained by a single kite above 3,000 feet.

COMPETITORS.

MAJOR B. BADEN-POWELL, Scots Guards.
President Aëronautical Society.

Mr. E. ERNEST BARCLAY.

Mr. CHARLES BROGDEN.

Mr. ALAN BURGOYNE

Mr. S. F. CODY.

Mr. L. CODY.

Mr. BERNARD D. LANG.

Mr. S. H. R. SALMON.

JURY.

Dr. NAPIER SHAW, F.R.S.
(Chairman of Jury).

Professor C. V. BOYS, F.R.S.

Mr. E. P. FROST, J.P., D.L.

Sir HIRAM MAXIM.

Dr. HUGH ROBERT MILL, LL.D., F.R.G.S.

Mr. E. A. REEVES, F.R.G.S.

Mr. ERIC STUART BRUCE, M.A. Oxon, F.R. Met. Soc.

ENGINEERS.

Mr. J. E. DALLAS, } *Royal Engineering College, Coopers Hill.*
Mr. N. F. MACKENZIE, }

The COMPUTER.

Mr. W. MASON,
Demonstrator, Engineering Laboratory, King's College, London.

STEWARD.

Colonel F. C. TROLLOPE,
Late Grenadier Guards.

Two competitors, Mr. Alan Burgoyne and Mr. B. D. Lang, were obliged to withdraw at the last moment owing to accidents having occurred to their respective kites

Digitized by Google

INTERNATIONAL KITE COMPETITION.



Mr. S. F. Cody adjusting his Kite.



Mr. L. Cody's White Kite.

Digitized by Google

during rehearsal. Six competitors started their kites, and the first series of observations taken by means of the theodolites were of all six. Two competitors, however, fell out, and the observations were continued for the rest of the time on the remaining four.

The result, which will be more fully dealt with in the report, was as follows:—

THE MEAN OF THE OBSERVATIONS FOR ALTITUDE.

	Feet.
Kite No. 6 (Mr. Charles Brogden)	1,554
Kite No. 7 (Mr. S. F. Cody)	1,326
Kite No. 8 (Mr. L. Cody)	1,271
Kite No. 2 (Mr. S. H. R. Salmon)	1,189

THE ACTUAL GREATEST HEIGHT OBSERVED FOR THE KITES.

	Feet.
Kite No. 6	1,816
Kite No. 7	1,407
Kite No. 8	1,476
Kite No. 2	1,339

It will be seen that Mr. Charles Brogden's Six Winged Kite, of which an illustration is given, is first, both in the mean of observations and for actual highest flight observed. Mr. L. Cody's Kite has the second place for highest flight observed, though in the mean of observations he takes the third place, the average of heights in his case not being so well maintained as in the case of Mr. S. F. Cody's Kite.

As the required altitude was not attained by any of the Competitors the Silver Medal is not awarded.

Aëronautical Exhibition.

The following is the list of photographs and objects exhibited.

Mr. W. H. Dines, M. Aer. Soc. *(President of the Royal Meteorological Society, 1901-2:*

1. Charts obtained from self-recording instruments sent up by attachment to a kite at Crinan, N.B.

July 15. Maximum height 6,250 feet.

Aug. 12. Very light wind. The Chart is interesting, as showing the very dry air found at a few hundred feet elevation.

Aug. 23. Maximum height 11,850 feet.

2. Set of six photographs relating to observations obtained in Crinan.

3. Plan of making eye at end of wire, and also plan of joining two wires. The steel wire is passed through the brass tube and the end hooked over before the latter is bent. The steel wire is not softened.

4. Clamp for attaching supplementary kite to line.

The wire is placed between the two rings at the end of the clamp, it is then turned spirally some ten times round the tail of the clamp, and the line from the supplementary kite is secured to the rings.

Professor G. H. Bryan, M. Aër. Soc., F.R.S., and Mr. W. E. Williams:

Photographs of the paths of aërial gliders.

These photographs were taken by attaching magnesium wire to small gliders, consisting of square planes and pairs of square planes, and allowing them to descend in front of a camera in a dark room with the wire burning. By placing a rotating wheel in front of the camera, a dotted instead of a continuous track was obtained, enabling the velocities at different points to be compared. When the path is nearly straight two sets of oscillations are observed. If either of these oscillations increases as the glider descends, the glider will be longitudinally unstable. A mathematical investigation of the longitudinal stability of gliders has been specially prepared for the Aëronautical Society of Great Britain by Professor Bryan and Mr. Williams, and will be read at an early meeting next session.

1. 2. 3. Single square planes.

4. Single square plane showing instability.

5. Two square planes gliding at a large angle with the horizontal.

6. Two square planes inclined at a small angle.

7. Two square planes set at an angle of 15°.

8. Two square planes inclined at an angle of 10°.

9. Two square planes at a small angle showing instability due to increase of oscillation of small period.

10. Two square planes at a small angle.

The Rev. J. M. Bacon, M. Aër. Soc.:

1. Two pictures, each giving a series of snapshot photos. illustrating the inflation and ascent of the Maskelyne-Bacon hot-air balloon.

2. View of the sea-bottom in 10 fathoms of troubled water, photographed from a

balloon at a height of 600 feet over the Irish Sea.

3. Four views of land, sea and cloud, taken during the above voyage.

4. Three views of city and cloudscape taken over London.

Aëronautical Society of Great Britain:

1. Illustrations from the Aëronautical Journal published by the Council of the Aëronautical Society of Great Britain.

2. Prints of Aëronautical Celebrities:

(1) The late Mr. James Glaisher.

(2) The late Mr. Percy Pilcher.

(3) Monsieur Janssen, Director of the Observatory of Physical Astronomy at Meudon, Paris.

3. Plaster Casts of The Sparrow Balloon Coins, presented by the keeper of the Coin Department, British Museum.

The balloon ascent recorded by these coins was made on June 13th, 1823, from the Oxford Gas Works, in commemoration week, by Mr. Isaac Earlyman Sparrow, an enterprising ironmonger, who advertised by coins or tokens, accompanied by Mr. Green, the famous aëronaut, to whom the balloon belonged. The three representations of the balloons in the coins would seem in each case to be from the pen of different draughtsmen. (See *Aëronautical Journal*, October, 1901.)

4. Photographs of the Anderson Kite Equipment of the Scottish National Antarctic Expedition.

1. Winding gear. 2. Box kite.

Eric Stuart Bruce, Esq., M.A., Oxon, F.R. Met. Soc.:

1. Charts of the wind forces taken near the summit of the Eiffel Tower, Paris (305m.), during M. Santos Dumont's experiments with his navigable balloons in 1901, Figure 9, showing that a wind force of 5 metres a second was overcome by the experiment.

2. Post card illustrations of the Vincennes Balloon Competitions, presented to the exhibitor by M. Jacques Faure, the late Treasurer of the Paris Aëro-Club.

Mr. A. South, M. Aër. Soc.:

Two models of the South and Groombridge propellors for aërial purposes.

Mr. William Cochrane, M. Aer. Soc.:

Working model of mechanical bird, fitted with oscillating feathering propellers and new horizontal tail stearing gear.

Mr. S. F. Cody: Photos of Man-lifting Kite

* * *

The Wind Forces overcome in the Experiments of M. Santos Dumont with his Navigable Balloon in Paris 1901.

By a Member of the Paris Aëro Club.

As will have been seen above, in the recent aëronautical exhibition held on the occasion of the International Kite Competition, there was exhibited a map of the wind forces overcome by M. Santos Dumont during his experiments with his navigable balloon in Paris, 1901. As the main point at issue in a navigable balloon journey is the wind force actually overcome, and as it is a question which in the published accounts of M. Santos Dumont's experiments has been begged, notwithstanding its importance, it may be acceptable to the readers of this journal to offer some explanation as to the connection of the charts here reproduced with M. Santos Dumont's journeys.

The first chart (Fig 1) representing the wind force at the summit of the Eiffel Tower (305 metres) during the experiment of July 12th, 1901, shows that there was absolute calm at the Eiffel Tower during from 3 o'clock in the morning until nearly 10. Here were the ideal conditions for a navigable balloon, and they were used to the greatest advantage. On this day M. Santos Dumont made thirteen voyages, ten round Longchamps, one to Puteaux, one to the Eiffel Tower, and another to St Cloud. In one day he, therefore, beat the previous record of the voyages made in a navigable balloon, and showed his mastery of the vertical motion of the balloon in a calm atmosphere by keeping at an altitude not exceeding 270 metres for a total distance of 45 kilometres.

On the thirteenth of July M. Santos Dumont made his first attempt to win the Deutsch Prize, which was open to any aëronaut who should steer a balloon from the grounds of the Aëro-Club round the Eiffel Tower and back in half-an-hour. On the day mentioned he failed to accomplish this feat by ten minutes. In the French account of the journey it is stated

Digitized by Google

CHARTS.

Vitesse moyenne du vent en mètres par seconde au Sommet de la Tour Eiffel (305 mètres au-dessus du sol). Direction du vent au Bureau Central Météorologique (18m au-dessus du sol) et à la Tour Eiffel observées aux heures indiquées.

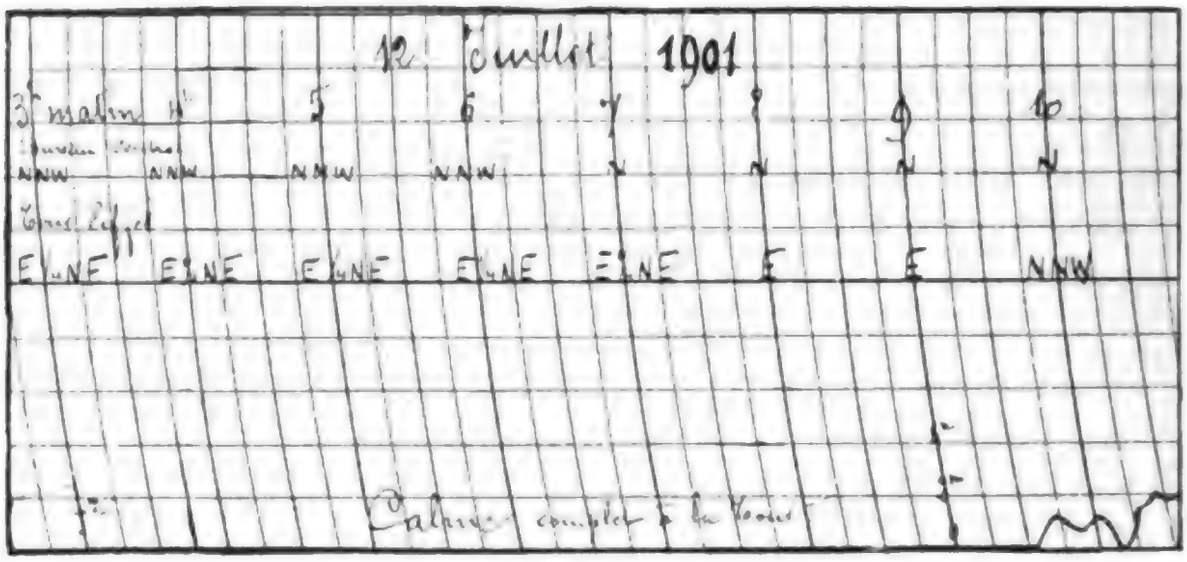


Fig. 1.

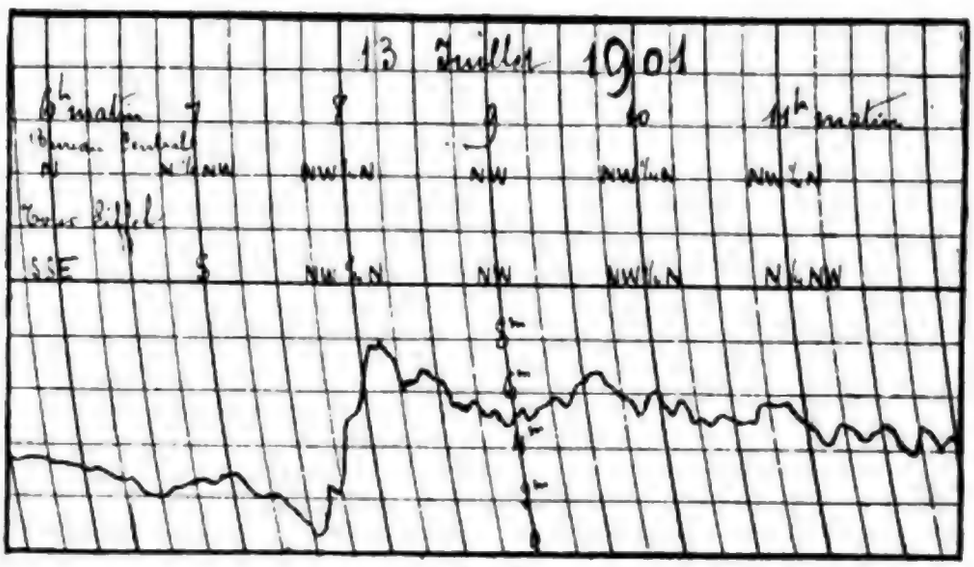


Fig. 2.

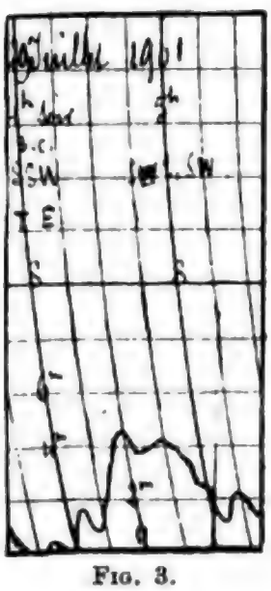


Fig. 3.

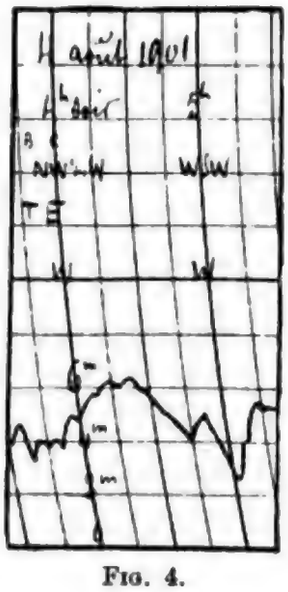


Fig. 4.

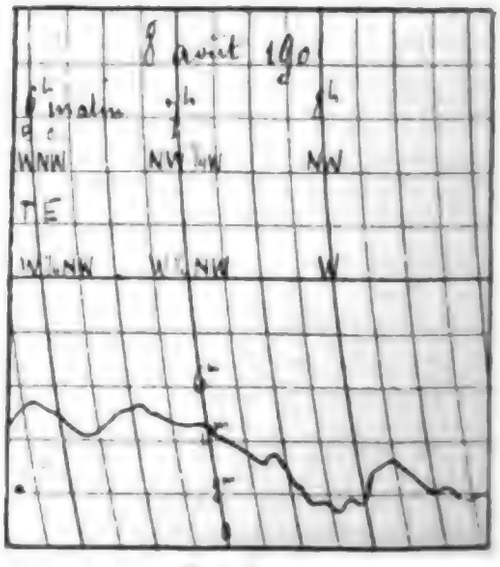


Fig. 5.

Digitized by Google

CHARTS.

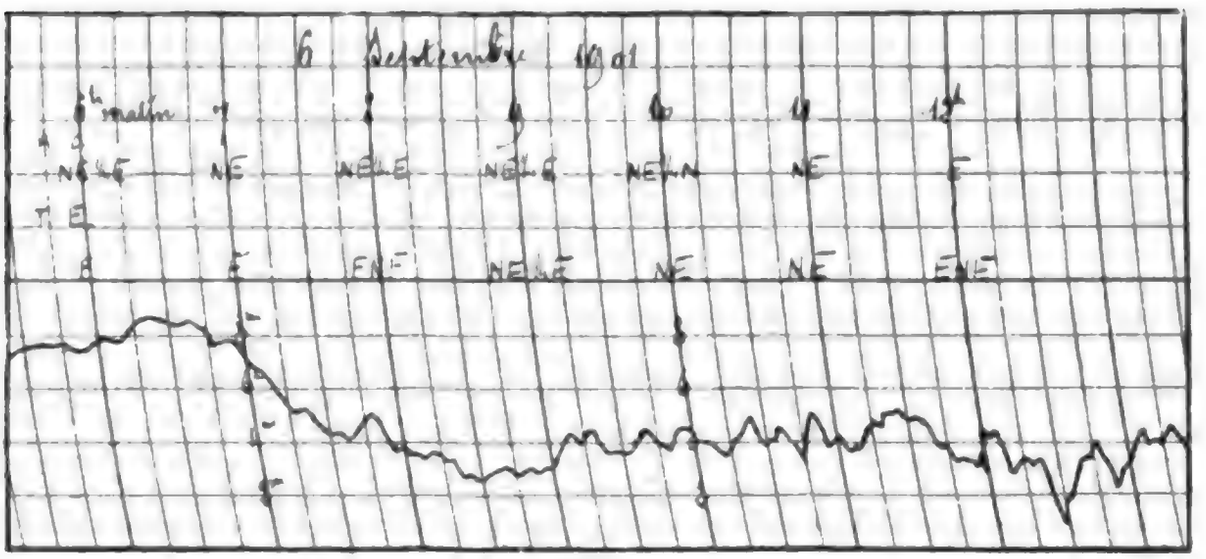


Fig. 6.

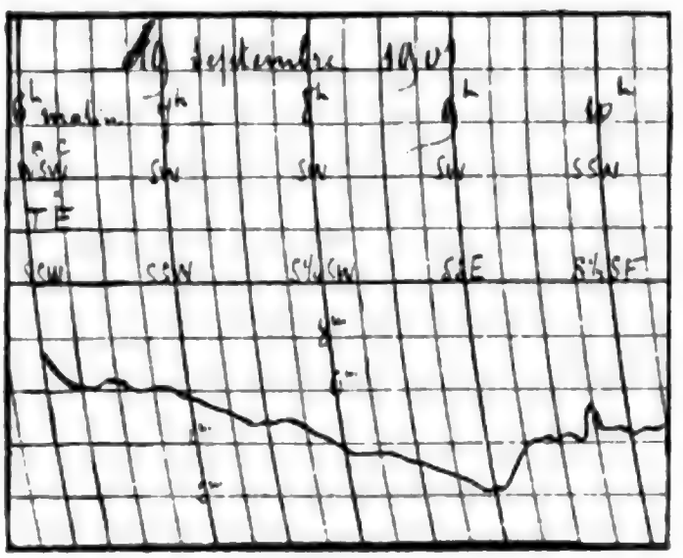


Fig. 7.

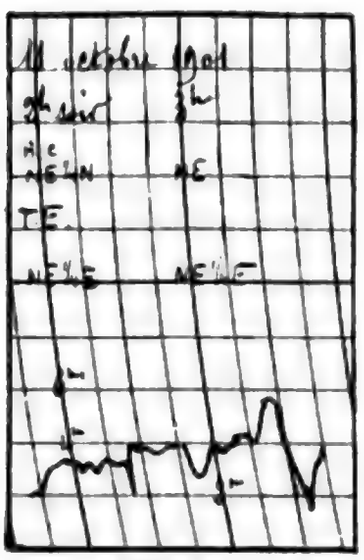


Fig. 8.

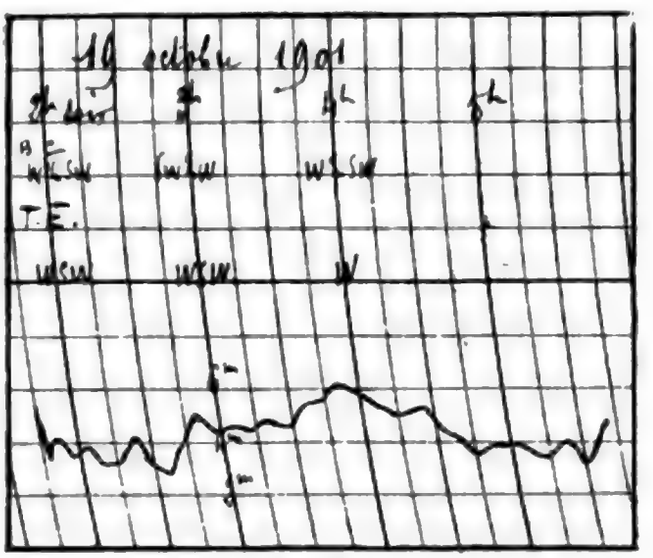


Fig. 9.

that for ten minutes of his return journey with his motor running down, M. Santos Dumont went against the wind, and the force of the wind had redoubled. A glance at the chart of that date (Fig. 2) shows that the balloon, in returning, went against a wind, but a wind of only one to two metres, the journey being accomplished between 6.41 and 7.21 a.m. The time of this journey was prolonged by the collapse of the motor. In the reports it was stated that the motor was enfeebled by the force of the wind. This was, however, a fallacy, as the wind force throughout the whole of that experiment was next to nothing, as shown by chart 2. At 8 o'clock the wind force increased, it is true, to eight metres per second, but by that time the journey had terminated.

The journey of August 8th was remarkable for the accident due to the collapse of the ballonet apparatus, which precipitated M. Santos Dumont on to the roof of the Trocadero Hotel, and not on account of any high wind force. It is claimed that on this journey the record of speed, viz., five kilometres 500 m., was accomplished in 9.m. 7″, on going with the wind to the Eiffel Tower, the wind force being from four to five metres per second. It was thought that on this day he would accomplish the journey round the Tower in less than the required time, though, in returning, the wind was against him at a rate of from four to five metres a second. But the accident which shattered in pieces the No. 5 balloon put an end to what might have been a more brilliant performance than the final one of October 19th.

The chart of September 6th (Fig. 6) shows the wind forces on the first journey of the No. 6 balloon, in the construction of which new details of interest were added, such as the employment of liquid ballast. The motive power was increased to 20-horse power, but it will be seen by the charts that the increase of horse power did not appear to tempt M. Santos Dumont to combat a greater wind force than he had previously with his No. 5 balloon. On September 6th various evolutions were made with his new balloon, but they were terminated by an accident owing to the rudder not being well adjusted. Other excursions, though not definite return journeys, were made on September 19th and October 11th (Figs. 7 and 8), in which winds from seven metres to two metres a second were registered.

On October 19th (Fig. 9), the day on which M Santos Dumont won the Deutsch Prize, at starting from St. Cloud at 2.42 p.m. the registered wind at the Eiffel Tower was 4½ metres a second. As he approached the Tower it amounted to five metres a second, but when he arrived it had abated somewhat. The journey to the Tower was with the wind, and he arrived there in about nine minutes, having traversed an apparent distance of about 5½ kilometres; though, in calculating a balloon course, it is impossible to state the actual length traversed on account of the veering of the balloon from local air disturbances until instruments are used which can locate the balloon and compensate these divergencies. The dirigable balloon seems to have doubled the Tower at about the level where the wind observations were taken. The journey back was apparently executed against a wind of rather less than five metres per second. Being against the wind the return journey was slower than the journey out, the balloon appearing to have difficulty in combating the wind, veering and swaying heavily. It was noted that in rounding the Tower the balloon veered considerably. This fact may be ascribed in part to the length of the balloon, for, with extension of the axis of the balloon and of the wind, a larger surface is exposed to the wind, and this is one of the dangers of the elongation of balloons. At 11 minutes 30 seconds after 3 p.m. the balloon arrived above the Aëro-Club enclosure. The actual journey had taken 29½ minutes, but the balloon was high in the air, and by the time it had been lowered and the guide rope seized, according to the conditions of the Deutsch Prize, the time had been exceeded by a few seconds. The guide rope was seized at 12 minutes 40 seconds past 3. Everyone is aware of the consequent dispute as to whether the prize had been won and its final award to M. Santos Dumont. This last journey appears to be somewhat typical of the wind forces that have been overcome in the Santos Dumont journeys. The dirigable balloon appears on this occasion to have rounded the Tower at about the level of the observatory, where the wind observations were taken. The progress in overcoming the wind seems, therefore, to consist in having overcome a wind force of about one metre and a half per second greater than that overcome by Captains Krebs and Renard in 1885. The latter, however, had only 9-horse power, whereas the former had more than double at his disposal.

The height at which the above-mentioned wind forces were taken (305 metres) fairly represents the altitudes attained by M. Santos Dumont; but in quoting the above wind forces it must be remembered that M. Santos Dumont sometimes travelled below the height

of 305 metres, therefore, the wind force at the precise level at which he travelled may not in reality have always quite reached the figures above quoted. It is clear that the only reliable figures would be those taken on board the airship. Here arises a difficulty. It is not an easy matter to locate a dirigable balloon or a free balloon of any sort, and on such a location all calculations would have to rest. M. Santos Dumont and his partisans are of opinion that such a location is an impossibility. They consider that the length of time of a balloon journey and the number of miles known from place to place would be no measure of the actual course traversed, owing to the fact that such a body is rarely still and in one place. It is affected by vertical currents of air, by movements in the horizontal layers of the atmosphere, by movements set up by the action of its own rudder and its own screw, and its consequent oscillations render unprecise the appearance of the panorama beneath, upon which measurements might be based.

On somewhat the same grounds M. Santos Dumont and his partisans appear to have no faith on the calculations of his own speed deduced from the reading of an anemometer on board. On July 12th, on a very calm day, he took up an anemometer to see what it would register, and it showed 40 kilometres an hour, a reading in which he had no confidence. He considers that the non-comparable inertia between the balloon and the vanes of an anemometer, affected by the various currents alluded to above, would alone falsify results, and they extol the commission for having not made a wind velocity a condition of the prize. But there is a school of French aëronauts who maintain that M. Santos Dumont and his colleagues are in error in such statements, and that with the instruments now at our command, a balloon could be located, that the error arising for the veering could be compensated, and that various exact measurements could be deduced.

If the actual advance to aërial navigation in M. Santos Dumont's experiments is small, the picturesque nature of the manner of doing and the very great personal qualities the attempt called forth in the doer, have had a moral effect far in excess of what was warranted by the mere quantitative index of progress. M. Santos Dumont himself ascribes the new period of activity in aëronautics to the evolution of the petroleum motor through the autocar. But he, perhaps, modestly forgets the power of individualism and the impetus to experiment that his own persistence has accumulated.

Experiments relative to Equilibrium and Angle of Fall in Gliding Flight.

By Major L. S. Blackden.

Recent experiments have led me in two directions—both a good deal governed by considerations of construction, which, in any case, is always poor.

In one direction I improved the steadiness of flight, but was very dissatisfied with the angle of fall; in the other direction I improved, by diminishing, the angle of fall, but was extremely dissatisfied with the steadiness of flight.

In trying different wing profiles—such as could be easily made by bending a piece of thin cardboard, I found the steadiest forms were those that required the centre of gravity to be furthest forward, but they did not give good angles, while the best angles were given by shapes which, wherever the centre of gravity was, would always pitch forward unless controlled by a large and well turned up tail.

It appeared probable that in the steady form with the bad angle all the lift came from a limited part of the wing near the forward edge, while the bulk of the after part of the surface acted more or less as a steadying rudder or tail. Figs. 1 and 2 give a steady and inefficient, and an efficient but unstable section respectively.

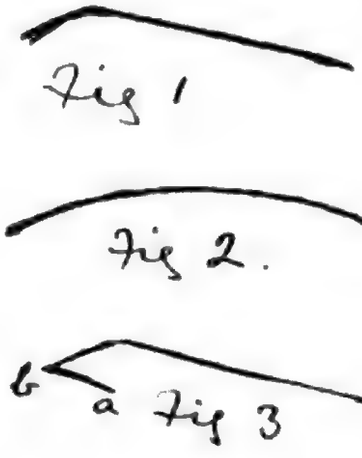


Fig. 3 shows a section, which glided steadily with no tail or guiding surface at all. In this section I supposed that probably all the lift came from the back-turned part, a-b, and that the whole after part acted as a tail or rudder. Its angle of fall was barely one in one.

I then turned my attention to the tail, which must be turned up in order to prevent any curved surface from pitching over forward, and tried various shapes.

I found breadth of spread of more importance than length from front to rear in securing steadiness, and the best fore and aft section was one the anterior half of which was flat, whilst the posterior half was curved. Vide Fig. 4.

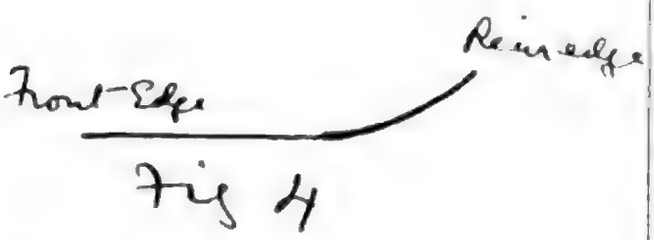


Fig 4

Here, again, the tail that gave the steadiest flights gave the worst angle of fall—the upturned end acted, probably, more or less as a drag.

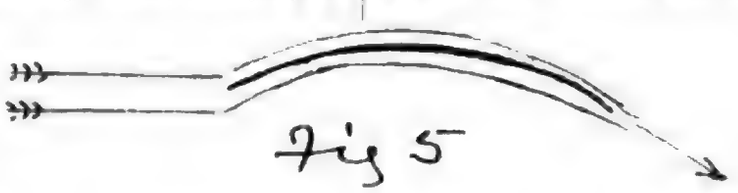
When experimenting with tails I found that a big tail, well turned up, would always give steady flight, though the angle of fall might not be good. It also allowed of a wide range of position for the centre of gravity in a fore and aft direction. A glider so made, with the centre of gravity about one-third of the wing-breadth from the front edge would glide fairly well. Closer to the front edge it did better but required to be thrown with greater speed.

I then placed the centre of gravity in front of the front edge of the wings. The glider would not glide by its own weight at all, but if thrust vigorously forward would sail across the room almost horizontally and very steadily, but its course began to sink towards the end, and if tried where there was enough space, would finally fall on its head. Evidently a sufficient speed would cause such downward pressure on the tail, and such upward pressure on the wings, that, to balance these pressures, the centre of gravity would have to be in front of the wings. Greater speed did not make it mount upwards, but allowed the glider still to sail horizontally, provided the centre of gravity were placed sufficiently forward.

This experiment suggests that in a motor-propelled machine there should be some arrangement by which the aëronaut, during flight, could alter his position through a considerable distance in a fore and aft direction, in order to allow him to use different speeds—exceeding "soaring speed"—without departing from a horizontal course. The constant connection of steady flight with a bad angle seems to suggest that an increase of safety in dynamic flight depends on increasing the proportion of power to weight in the motor. But for the present, and for some time to come, safety will depend chiefly on the skill of the aëronaut, and the constructional strength of the machine.

In endeavouring to obtain a greater steadying power with less upward angle of the tail, it struck me that I might utilise the downward current of air at the posterior edge of the wing—supposing the air to be deflected downwards in passing the wing, as in Fig. 5.

I, therefore, made a glider with a good lifting section of the wings, namely, a circular curve in the fore and aft direction, while remaining straight transversely—like a slice from the top of a horizontal cylinder—and attached to it a tail, curved like the wings, only with


Fig 5

the hollow side upwards, so that the leading edge of the tail was vertically beneath the rear edge of the wings and close to it, as in Fig. 6.

This glider flew steadily with the tail set at a smaller upward angle than I found necessary when I applied the tail with its front edge continuous with the back edge of the wings as in the dotted line in Fig. 6. The improvement of the angle of fall was, unfortunately, not so

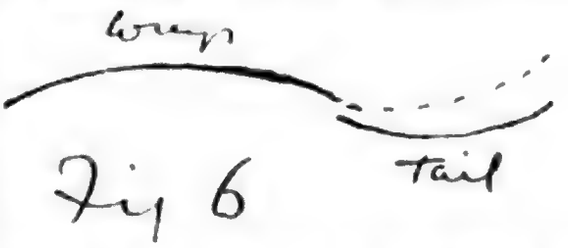


Fig 6

marked as the reduction in the angle of the tail led me to hope.

I then made a glider on the same principle, but with the transverse spread of the tail equal to that of the wings, but a good deal shorter from front to rear—being about two-fifths of the width of the wings from front to rear. Vide Fig. 7.

The tail was attached to the wings both at the centre and ends.

This model glided very steadily and at a very good angle, but it was very light for its surface, spreading, as it did, 31½ square inches of

wing-surface to only about 7-8ths of an ounce weight, or at the rate of about four ounces to the square foot, and I have always found that the lighter a model is, the flatter

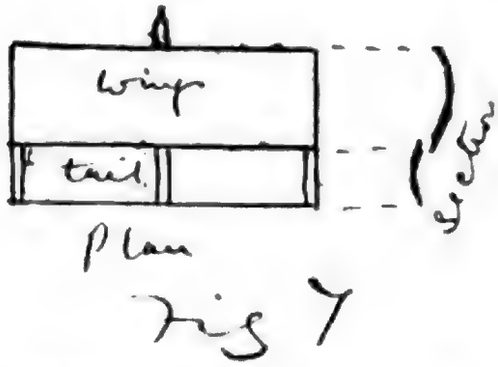


Fig 7

is its angle of fall, due to wing edges and framing generally giving less proportionate resistance at lower speeds.

About the same time I tried a new section without a separate tail at all. This was, as

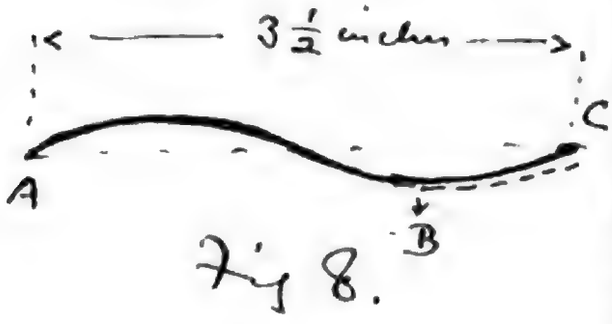


Fig 8.

usual, straight transversely, but curved into an S in the fore and aft direction. Each half was bent to the arc of a circle, having the height of arc equal to a twelfth of the length of chord. The front half had the concavity beneath, the rear half having the converse side downwards as in Fig. 8.

With this section I thought it possible that some lifting effect would be obtained from the anterior three-quarter of the surface, A B in the Fig., and that the posterior quarter, B C in the Fig., would act as a steadying surface, or tail only.

The dimensions were as follows:—

Spread 18 ins. Total width 3½ ins.

Supporting surface = ¾ (3½ × 18) = about 47 sq. ins.

Weight 2 ozs.—or about 6 ozs. to the sq. foot.

This was also steady, and flew at a fair angle—better than I had yet obtained with any glider except that shown in Fig. 7. I added a weight of lead, which brought it up to the proportion of 1 lb. to the square foot, and threw it out of doors. The flight was fairly steady, but with a small and quite slow rocking motion, and it fell at an angle of about one in five. It struck the ground with one wing before the other and broke.

Its good angle—for I find one in five is good for a small, and I fear roughly-made, model, when heavily weighted—probably due to its considerable spread in comparison to width of wing, and its stability, like that of the model shown in Fig. 7, due, in part at least, to the fact that every part of the wing had its own bit of tail to steady it. I have generally found long narrow wings more difficult to balance than short and wide ones, and I think that, in my experiments at least, part of that difficulty was due to the greater flexibility of the long and narrow wing, which allowed a great part of the outer end of the wing to begin to upset before it felt the steadying influence of the tail.

To recapitulate, I had found that, with wings straight transversely, a circular curve in the fore and aft section—"cylindrical" wings in fact—gave a better angle of fall than the other shapes tried, but had a strong tendency to plunge or pitch forward, which was best corrected by a tail extending transversely the whole length of the wings and attached as rigidly at the ends as the centre. It did not require to be as wide—fore and aft—as the wings, nor was it necessary to give it as deep a curvature as the wing, and it seemed to give a rather better angle of fall, and certainly did not require to be turned up so much, when its front edge was just below the back edge of the wings, than when in prolongation of the back edge as in the S-shaped section (which went best when the rear quarter had been flattened a little as in the dotted line in Fig. 8). The best curvature of the tail was found to be flat near the front edge and curved behind. In diminishing the spread of the tail transversely, it had to be increased in length from front to rear, and turned up at a greater angle—which increased the angle of fall owing to its greater drift in proportion to its depressing, or steadying power.

With regard to the theory* that the air, in passing the wing, follows the surface exactly, and, striking the front edge with a relatively horizontal motion, leaves the rear edge with a relatively downward motion, and thus tends to lift the wing, as in Fig. 5—this explanation does not seem to apply to the S section men-

* "Aëronautical Annual," 1896, p. 41.

tioned above, *vide* Fig. 9—and yet this section undoubtedly lifts, and lifts well, and has the advantage of having no tendency to plunge.



If a surface of this form is turned upside down, as in Fig. 10—when, according to the theory mentioned above, it ought to lift, as the air striking horizontally, and following the surface, should leave it with a downward trend—it not only does not lift, but it is certainly pressed forcibly downwards.



(The air currents represented in Figs. 5, 9, and 10, are supposed to follow the surface parallel to it.)

My "cylindrical" wings did not all behave alike. I probably made them badly, and the flexibility may have differed in different models, so that I cannot say what shape they took under pressure. At any rate, I often—but not always—found that they rocked with varying violence from side to side, as I mentioned in my last paper.

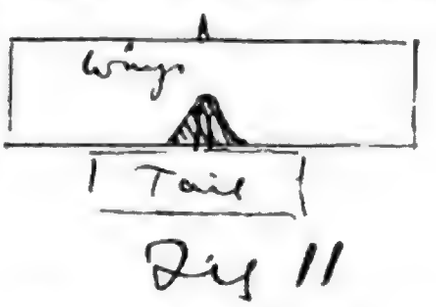
I had one the other day which did nothing but rock. Not only did the wing-tips alternately move up and down, but the whole glider at the same time oscillated from side to side. I made quite sure that, in this model, presenting the wings to the air at a flatter angle did no good at all in preventing this rocking, although it certainly diminished it.

All the gliders that rocked in this way gave the impression that they were "spilling the wind" from under the wings—that is, that compressed air had gathered in the hollow of the wing, and that this air escaped, first at one end of the wing-surface and then at the other. It reminded me of the rocking of a parachute in descent, and strongly suggested the necessity of something to correspond with the hole in the top of a parachute.

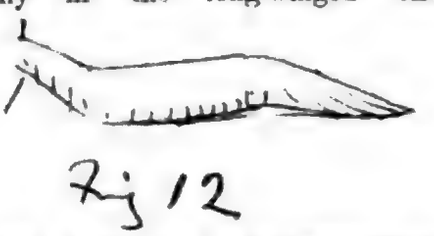
I took the glider that rocked so persistently and cut a wedge or V out of the back edge of the wing-surface in the centre—*vide* Fig. 11—to allow the compressed air, if such there were, to escape.

The result was wonderful. The rocking entirely ceased, and I secured steady glides, both in and out of doors, with that glider as long as the wings retained any approach to symmetry.

This result interested me very much, especially with reference to the shape of the wing in



soaring birds. These birds' wings have a negative angle near the body, and sometimes, especially in the long-winged birds, a



diminished width, as in Professor Pettigrew's figure of the wing of the albatross—which is more or less like that shown in Fig. 12.

Both the negative angle and the diminished width would allow of the escape of compressed air near the body, exactly as the V-shaped cut in my models, and, on the principle of equal and opposite reactions, the escape of air at that point would have the very valuable effect of driving the thickest portion of the wing forward through the air, thus making full use of the downward curve at the front of that portion of the wing.

The fact of the wing-arm, between the elbow and the wrist, always pointing forward, would assist in directing the air towards the back edge of the wing near the body.

I, therefore, made two new models, one having wings shaped like a section of a horizontal cylinder, and the other having wings of the same shape, but cut in two at the centre, and each half attached to the body with a forward inclination, *vide* Figs. 13 and 14.



Fig 13

These two models were the same in weight and area of both wings and tail, but the tail of the second, Fig. 14 (No. 2), did not get the full effect of the down draft from the back edge of the wings as well as in the other, Fig. 13 (No. 1), owing to the forward inclination of the wings.

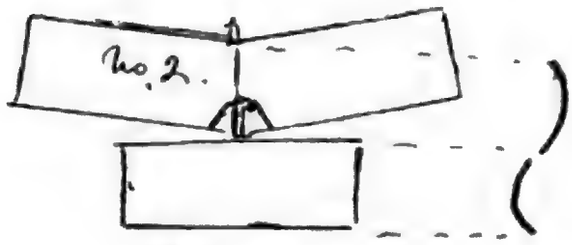


Fig 14

I expected greater steadiness and a better angle with No. 2 than with No. 1—but I didn't get it.

At first No. 2 seemed a little the best, but when I cut a V in the back of the wings of No. 1, it distinctly beat No. 2, both in steadiness and angle of fall.

The explanation lay in the fact that I was letting the air escape too easily, so that less compression took place, and there was not sufficient support.

This model (Fig. 14) did distinctly better when I gave the wings a slight dihedral angle. The air, coming in so easily from the wing ends was given a downward trend by the dihedral angle, and so did a little work. Evidently if the wings were not only curved from front to rear, but also from ends to centre, as in Fig. 15, with an escape behind the centre, a much better lift would be obtained without increasing the drift. This shape is, in fact, that of the gull's wing, and more or less of all soaring birds.

A model in this shape involved the difficulty of making a wing with a double curve, a difficulty which, so far, has rather defeated me. I have, however, made several models, some of which have, when new, flown fairly well. The first one I made bore out the theory, but a second, with the wings pointing forward less than the first, that is, one in which the two

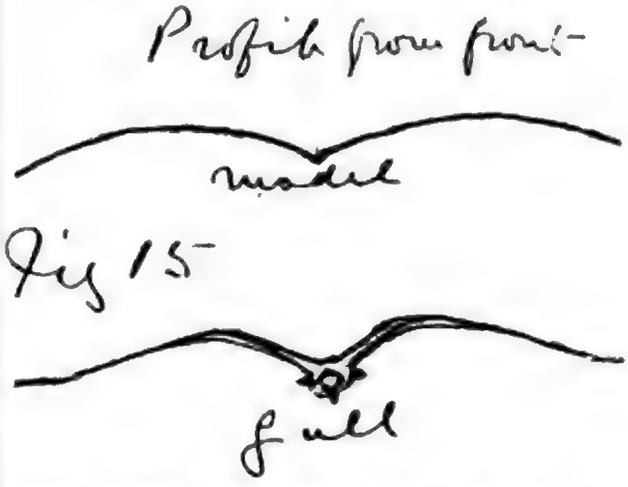


Fig 15

wings were more nearly in a straight line transversely, did better, and I got my best results when I no longer made the wings point forward at all. This model rocked very rapidly and violently until I had cut the little V out of the back. After doing so I got from it the best flights I have ever had. It often flew from my hand till it struck the window at the opposite end of a 21-ft. room with a total fall of 3 or 4 feet.

Its flight commenced with a swoop downwards at a considerable angle, so that I estimated its angle of fall for the last 15 feet as sometimes no more than one in ten. This model was only 7 ins. across the wings.

These gliders were difficult to balance. When they flew well and straight indoors they did as well out of doors in a light breeze. When the breeze is strong there is generally a downward trend over the greater part of my garden. It is a small garden with two high

Digitized by Google

trees in front of the house, the branches of which deflect the wind downwards. I have confirmed the fact of this general downward trend by watching the movements of tobacco smoke over different parts of the garden.

Indoors, these models with double-curved wings often flew straight from my hand, and swooped till they had, so to speak, "got into their stride," when, without apparent cause, they suddenly upset, or sometimes only partially turned over, and commenced a new swoop in a new direction. The upset was usually to the same side time after time, and often I could only make them fly decently by bending the wings till they were so unsymmetrical that they ought to have upset at once.

I found out at last, in one model, that one of the wings was a little weak at its junction with ...e body, and that when both wings appeared to the eye to be quite symmetrical, a slight pressure under the wings would cause one of them to "set back" slightly, and it was this setting back of one wing when under full pressure that caused the sudden upset in the middle of a steady flight.

These double-curved wings were never so stiff as the cylindrical ones, and their falls and collisions with furniture, etc., tended to bend down the outer front corners of the wings, so that in flight the wing ends probably tried to plunge or pitch forward, and, not being prevented by the tail until they had reached the limit of their flexibility, brought about a condition of things in which the wing-tips had a negative angle and the centre had a positive angle—a condition of things the opposite of that which obtains with the birds. If the flexibility of the two wings was not exactly the same—and I don't suppose it ever was—one wing would turn down more than the other and bring about a rapid revolution on a fore and aft axis—as usually happened.

This only took place when the wings were under full pressure.

I tried to add an upward curve to the whole back edge of the wings, as in the S section glider, but with a double curve to negotiate it was not easy. I failed to get any really good flights with such an arrangement, either in steadiness or angle of fall, but it certainly eliminated the sudden upset in the middle of a steady flight, and so tended to confirm my diagnosis of the cause of such upset, and of the steadiness of the long, narrow, and weak glider with the S section, which broke after its first and only glide out of doors.

In trying different kinds of tails attached only at the centre with the double-curved wings with the central opening behind, I got the best results from a tail, whose spread and length were equal to one another, and a little greater than the width, fore and aft, of the wings. The downward air-stream came chiefly from where the back edges were cut away in the centre, so the tail did best when concentrated there.

I find that my rather timid suggestion, in my last paper, of using a partially adjustable



Fig 16

front rudder, to be operated by the aëronaut during flight (and which was so timid owing to my belief that it was quite new, and would be considered dangerous by all practical gliders), had already been left behind by the Messrs. Wright before I had thought of it. Now, finding a movable front horizontal rudder has been proved successful in a full-sized man-carrying machine, I am altogether an advocate

Digitized by Google

of making adjustments of balance depend entirely on the skill of the aëronaut in using such a rudder—but I would still have a horizontal fixed tail.

In order to control the tendency of a curved wing to pitch forward, however deep the curvature, I found that all that was necessary was to increase the angle at which the tail was turned up. With very deep curvature of the profile, and no front horizontal rudder, the tail had to be so sharply turned up that it added greatly to the resistance of the glider, and in fact acted as a drag as well as a true tail. The addition of the horizontal rudder in front permitted the tail to be turned less sharply up, and so gave a better angle of fall when once the whole glider was properly adjusted; but it also gave another item that might, from want of proper adjustment, prevent steady flight.

The same thing might be rather differently expressed by saying that for longitudinal stability a longitudinal dihedral angle is necessary.

Fig. 16 (1) shows the general shape to be followed, and (2), (3), (4), and (5) the different ways of following it.

The front rudder, while adding to the drift, adds at the same time a little to the lift, while the upturned tail decreases the lift while adding to the drift. A front rudder should, therefore, give the best angle of fall, but in practice the turned-up tail always gave the steadiest flight. I have once persuaded a glider to sail fairly well with a front rudder only, but I failed to repeat it. With a tail added that was so slightly turned up as to add little to the drift, and to be alone insufficient to prevent pitching, a front rudder acted well.

With wings of the "cylindrical" pattern—that is, straight transversely but curved fore and aft—a flap at the rear edge, turned slightly up, would, with the addition of a front rudder, be all that would be required to ensure longitudinal stability. This would be like my S section, with the rear curve much diminished, but with its full stability preserved by the addition of a front rudder.

With my double-curved wings I did not get quite such deep curvature in a fore and aft direction as in my cylindrical-shaped wings. The endeavour to get a curvature from root to tip tended to straighten out the fore and aft section, hence probably the comparative weakness and flexibility of these wings in my models.

A deep fore and aft curvature in small paper wings gives great rigidity, and in large wings would give room for a greater strength of construction with less resistance to advance from exposed struts and stays than would be the case with a slighter curvature, but a slight curvature gives a much better angle of fall than a deep curvature. The lifting power of wings has to be considered in terms of screw-thrust; that is, in comparison to their total drift and head resistance, in order to estimate the angle of fall. A deeply-curved wing would, therefore, be bad except for the possibility it offers of strong construction without so much exposed framework as would be necessary in a wing of less curvature, and which would detract from the good qualities of such a wing. The best wing profile will be a compromise, decided by considerations of construction and strength of materials.

My experiments suggest that the greater part of the lift of a curved wing is due to a slight compression of the air under the wing, which is caused by the inertia of the air particles in contact with the wing, and that of the underlying strata of undisturbed air. Vide Fig. 22.

The air passing over the wing is thrown up by the leading portion, and creates a slight rarefaction over the rear portion, and this is possibly all that gives a curved wing its tendency to pitch forward. A wing-profile which I tried, which had the highest point at about a

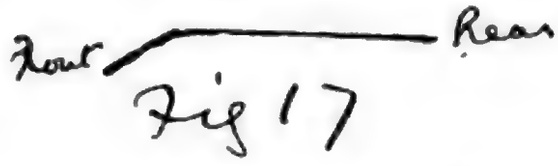


Fig 17

quarter of its breadth from the front edge, and the back three-quarters of which was a straight line, vide Fig. 17, gave less lift, but also had a less inclination to pitch. The centre of gravity in this case had to be placed further forward than in the case of a wing curved to the arc of a circle.

I presume that in this case the compression of the air did not extend so far back as if the curvature had been continuous up to the back edge, as air could escape more easily from under the flat part.

The air passing over the top of such a profile would create the same pressure on the front part—but owing to its greater steepness the pressure would act more as drift and less as downward pressure than in the circular profile—but after forming a slight rarefaction behind the highest point would probably have nearly reached its normal pressure again before leaving the back edge, and thus there would be much less tendency to pitch.

When the wind is blowing over a hill (vide

Fig. 18), I have seen birds soaring all over the windward side, and above the crest, and also, at a greater altitude, even behind the crest. From watching the movements of the gulls following a ship, and from the phenomenon shown in Fig. 18, I have always supposed the



Fig 18

crest of the wave of wind passing over any obstacle to be a little beyond the highest point of that which caused the wave. These con-

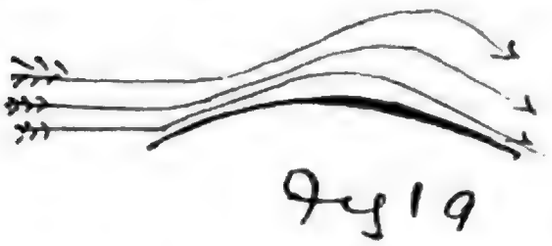


Fig 19

siderations lead me to suppose that wind blowing over a convex surface follows some such path as that shown in Fig. 19. (The arrows are so drawn as to exaggerate the behaviour of the air current.) This would cause compression in front and rarefaction behind, and if the profile was curved like the arc of a circle, the lift behind would not greatly exceed the



Fig 20

depression and the total effect, though contributing a little to the lift, would tend chiefly to upset the wing. With a steeper slope in front and a longer one behind, as in a parabolic profile (Fig. 20), even though there might still be the same proportion of power between the pressure in front and the rarefaction behind, the pressure in front would have less surface to act on, and its effect would be more felt as resistance and less as depression, while the rarefaction behind would act more as lift and less as drift, and would also act over a larger portion of the surface. The continuous curvature of the back part of the wing would produce a greater area of rarefaction than if the profile ended (as in Fig. 17) in a straight line. This form might then be theoretically considered the best for the upper surface of a wing, giving fair stability and a good lifting power without unduly increasing the drift.

The air passing under a concave surface appears, from experiments carried out by Phillips, Hargrave, and Merrill, and, perhaps, others, to have a tendency when the curvature of the surface is sufficiently pronounced, to turn over, like a breaking wave, and form a vortex, as in Fig. 21. It does not take much to cause an air current to do this, and even when it has most the effect of a steady stream, we should probably find, if we could follow its course, that it was full of swirls and eddies.



Fig 21

I once blew tobacco smoke across a thin sheet of sunlight, coming through a straight crack in the door of a mountain hut in Switzerland, and so obtained a section of the air currents, and it showed a most intricate pattern of whirls and curls.

The air passing under the front edge would probably cause a slight rarefaction immediately behind it, and that rarefaction might be maintained owing to the inertia of the particles of the compressed part beyond, but there would undoubtedly be a compressed part beyond, and the more the back part of the wing curved down, the nearer to the back edge of the wing would the area of compression reach; but at the same time the drift would be increased owing to the pressure everywhere acting in a direction normal to the surface of the wing. The rarefaction and compression would be the same under the wing if we consider the currents to follow the surface instead of forming eddies —and in a wing of slight curvature we should probably get a truer idea of their action by

considering them as doing so. The inertia of the air particles would cause the air currents not to change its direction until it had got a little beyond the obstacle which caused the change, as is the case with the wind passing over a hill. Vide Fig. 22.

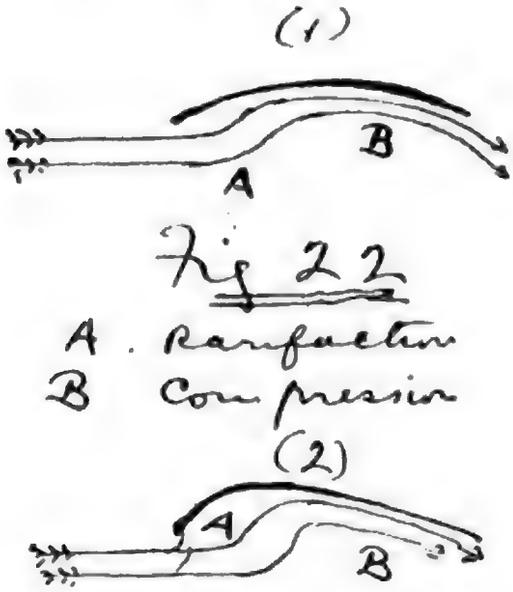


Fig 22

The steeper the front portion of the wing-curve the greater would be the rarefaction behind it, thus diminishing the lift, and adding to the drift.

This consideration suggests that the arc of a circle would be a better form of curvature for the under surface of a wing than a parabolic profile.

When once the compression had commenced, the constantly and evenly curving surface would keep up the compression to a point as close to the back edge as the decreasing inertia of the underlying strata would allow.

Evidently when the curvature of the wing is sufficient to bring about the partial rarefaction above the wing and compression below it, any further increase in the height of arc would add



Fig 23

to the drift in greater proportion than to the lift, so that a deep curvature, while adding to the total lift at a given speed, would decrease it when considered in terms of drift.

These considerations lead to a wing section parabolic above and circular below, as in Fig. 23, and is not this very like the curvature that the bird's wing has?

Close to the body the downward curvature of the under surface of the wing in front may be sharper, as in Fig. 24, as it is supplied with compressed air from the more distant parts of the forward-pointing wing.

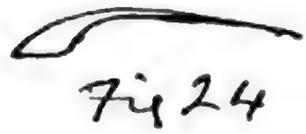


Fig 24

The sections shown in Figs. 23 and 24 would allow of a good many structural complications being completely enclosed within the wing, thus adding greatly to its strength, and so permitting a considerable diminution of the exposed struts and stays, which add so much to the head resistance of gliding machines.

Messrs. Groombridge and South's Exhibition of Aëronautical Apparatus.

This exhibition, which was held at 69, Regent Street from April 27th to May 2nd, 1903, was of a private character, and dealt with the aëronautical inventions of Mr. Charles Groombridge.

The following is a description of the various exhibits:

1. Model of a proposed aërial navigator, constructed upon a scale of one inch to a foot; the full size machine being about 80 feet in length by 60 feet in breadth. The general principle of construction is an arrangement of superposed aëroplanes, both in front and in rear of the propellers, with a larger one surmounting the whole machine. The propellers (six in number) are adjusted three on each side of the framework body of the machine, each pair being driven by a 20-horse power internal combustion engine. The total proposed force being 60-horse power. The machine is fitted with four ground wheels.

2. Model of Mr. Groombridge's new propeller for aëronautical purposes, mounted upon a stand and capable of being worked by hand, so as to show the action of the vanes. The general construction of the new propeller consists of a main or driven central shaft, which forms an axis within a rectangle, the two vertical sides of which form

the axes carrying the vanes. In the driving stroke the vanes extend outwards, beyond the rectangle, while they return edgewise or feathered within it. During the propelling stroke, the vanes become strained backwards, against the resistance of springs, and as the vanes yield to the air, the air remains practically unmoved, and thus becomes an inert or solid fulcrum against which the vanes press. As the vanes come into action they assume a vertical position, while at the completion of the stroke they automatically feather. The propelling stroke is effected upon a long or extending radius, the feathering upon a shorter one. The main central shaft carries opposite to each other two sets of vanes, so that one set is propelling, while the other is feathered, propulsion being continuous.

3. One half of the new propeller constructed with three vanes of large size, which would be suitable for use in a full-size machine. This was constructed by Mr. Patrick Y. Alexander, and at his expense, at Bathenston, and kindly presented by him to Mr. Groombridge.

4. A small vane of the new propeller fitted in bearings with a convenient handle, to enable the visitors to test by hand the great resistance offered by the air to the vane when in action.

5. Three vanes of the new propeller of a larger size fitted in bearings with convenient handle for same purpose as the preceeding.

6. Model of new method of steering. A feature in this method of steering, is the rapidity and ease with which the guiding vane can be changed from a passive to an active state. In a passive state its unobtrusiveness is very apparent, as when the machine is resting upon the ground the wind from any direction would have but a minimum effect upon it, while in the active position it causes the machine to feel its guiding influence in any desired direction; it can also be so adjusted as to utilize the force of the wind blowing at any angle.

7. Model of another new propeller, based upon the same principle as described in No. 2, that is, the straining of the vane backwards against the resistance of a spring: but in which the vanes are differently constructed, adjusted, feathered, and worked by very different mechanism.

8. Two vanes of this proposed new propeller mounted in a frame so that they can be conveniently worked by hand, their action explained, and the backward straining of the vanes by the air demonstrated by the operator.

Applications for Patents.

(Made in April, May, and June.)

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33 Cannon Street, London, E.C.

7763. April 3. DAVID HAYLOCK AND RICHARD ARTHUR HAYLOCK. **Self-lifting Flying Machine (without a Balloon).**

7969. April 6. ANTON WECZERA AND LEWIS WELLS BROADWELL. **Improvements in Flying Machines.**

8148. April 8. HERMANN HARTIG. **Device to be used for Flying Exercises.**

8595. April 15. SAMUEL FRANKLIN CODY. **Improvements in and connected with Kite Flying, and Apparatus employed therewith.**

8604. April 15. HORATIO FREDERICK PHILLIPS. **Improvements in or relating to Flying Machines.**

10990. May 14. RICHARD WHITTINGHAM. **An Improved Air-car or Flying Machine.**

12149. May 28. HENRY SHEPLEY BOOTH. **Improvements in Aerial Machines.**

13075. June 11. GEORGE CLOUT. **A Mechanical Air-Ship.**

Owing to pressure on space, the "Notes," "Foreign Periodicals," and "Notable Articles" are reserved for the next issue.

Digitized by Google

0.5 ENGINEERING LIBRARY
45

ENTERED AT STATIONERS' HALL.] PRICE (*to Non-Members*) 1s.

UNIV. OF MICH
AUG 4 1910

THE AËRONAUTICAL JOURNAL



Edited for the Council of the Aëronautical Society of Great Britain
By ERIC STUART BRUCE, M.A. Oxon, Fellow of the Royal Meteorological Society.

No. 28. OCTOBER, 1903. Vol. VII.

All Rights Reserved.]

Contents.

	PAGE.
NOTICES OF THE AËRONAUTICAL SOCIETY	63
EXCELSIOR	63
THE DE BRADSKY AIRSHIP. BY BARON V. SCHNEIDER *(Illustrated)*	66
THE SAILING FLIGHT OF THE TURKEY BUZZARD. BY T. H. HUGO	72
NEW BRITISH AIRSHIPS: 1.—THE SPENCER AIRSHIP. 2.—DR. BARTON'S AIRSHIP	74
THE ST. LOUIS EXHIBITION: 1.—THE AËRONAUTICAL SECTION. 2.—SUPPLEMENTARY RULES AND REGULATIONS GOVERNING THE AËRONAUTICAL COMPETITION	75
THE LEBAUDY AIRSHIP *(Illustrated)*	76
NOTES:—CROSS SEA BALLOONING—THE AËRONAUTICAL EXHIBITS IN THE METEOROLOGICAL EXHIBITION AT THE SOUTHPORT MEETING OF THE BRITISH ASSOCIATION—MR. STANLEY SPENCER'S RECENT NAVIGABLE BALLOON JOURNEY—M SANTOS DUMONT'S PRESENT TO THE FRENCH GOVERNMENT—AËRONAUTICAL EXHIBITIONS—COUNT HENRI DE LA VAULX'S BALLOON JOURNEY FROM PARIS TO HULL—PROFESSOR LANGLEY'S AIRSHIP MODEL	79
FOREIGN AËRONAUTICAL PERIODICALS	81
RECENT AËRONAUTICAL ARTICLES	82
APPLICATIONS FOR PATENTS	82

LONDON:
PUBLISHED BY THE AËRONAUTICAL SOCIETY OF GREAT BRITAIN, AND PRINTED BY KING, SELL & OLDING, LTD., LONSDALE CHAMBERS, 27, CHANCERY LANE, W.C.

Digitized by Google

. . THE . .

Illustrated Scientific News,

A MONTHLY JOURNAL OF POPULAR SCIENCE.

PRICE 6D., OR 7S. ANNUALLY.

Contributed to by many of the Leading Scientific Authorities of the Day.

The Aeronautical portion being contributed by Sir Hiram Maxim, Major Baden-Powell, and Mr. Eric Stuart Bruce, M.A.

To be had of all Booksellers and Newsagents,

OR OF **KING, SELL & OLDING, Ltd., Lonsdale Chambers, 27, Chancery Lane, London, W.C.**

WANTED. . .

Two Copies of No. 9

OF THE

AËRONAUTICAL JOURNAL

2s. will be paid for each Number.

Apply, KING, SELL & OLDING, Ltd.,

LONSDALE CHAMBERS,

27, CHANCERY LANE, LONDON, W.C.

BACK NUMBERS

— OF THE —

AËRONAUTICAL JOURNAL

Can be obtained from the Publishers:

Messrs. KING, SELL & OLDING, Ltd.,

Lonsdale Chambers,

27, CHANCERY LANE, LONDON, W.C.

Digitized by Google

THE AËRONAUTICAL JOURNAL.

OCTOBER, 1903.

The Aëronautical Journal.

(PUBLISHED QUARTERLY.)

SUBSCRIPTION PER ANNUM (post free), 4s.

Communications respecting Advertisements to be addressed to the Publishers, "Aëronautical Journal,"

Messrs. KING, SELL & OLDING, Ltd.,
Lonsdale Chambers,
27, Chancery Lane, W.C.

Editorial communications should be addressed to the Editor,

53, Victoria Street,
Westminster, London, S.W.

NOTICES OF The Aëronautical Society.

The opening meeting of the Thirty-ninth Session of the Aëronautical Society of Great Britain will be held at the Society of Arts, John Street, Adelphi, early in December.

On this occasion the report of the recent International Kite Competition will be read, the mathematical portion being prepared by Professor C. V. Boys, F.R.S., President of the Mathematical and Physical Section, British Association, and the descriptive portion by Mr. Eric Stuart Bruce, M.A. Oxon.

The other arrangements of the meeting will be duly announced.

THE LIBRARY.

Arrangements are being made for the Library of the Society to be open to members at stated times early in the new year, and full particulars as to such times will be duly announced.

ERIC STUART BRUCE,
Honorary Secretary.

EXCELSIOR!

Excelsior is the cry of the Twentieth Century. This is evident, not only from the columns devoted to aëronautics in newspapers and journals, but from the fact that aëronautical illusion and discussion is wending its way so widely into the addresses and transactions of the meetings of the British Association for the advancement of science. At the recent meeting of the Association at Southport no less than three Presidents of different sections of the great parliament of science made graceful allusion to the work of the late Mr. James Glaisher, "the intrepid explorer of the upper air: the Nestor of meteorologists," as Dr. Shaw, the President of the Subsection of Astronomy and Meteorology, so fitly described him. The connection between aëronautics and meteorology was, indeed, emphasised in Dr. Shaw's lucid and suggestive discourse. Most especially did he call attention to the valuable work of Professor Hergesell in the organisation of the international investigation of the upper air by balloons and kites. It is in his opinion a department which offers a

most promising field for future meteorological efforts. "It may very well be that observations on the surface will never tell us enough to establish a meteorological entity that will be subject to mathematical treatment. It may be that we can only acquire a knowledge of the general circulation of the atmosphere by the study of the upper air, and must wait until Professor Hergesell has carried his international organisation so far that we can form some working idea therefrom of general meteorological processes."

In the Astronomical and Meteorological Department of Section A, the subjects of kites and ballons sondes were expounded by the most thoroughly representative authorities—Mr. W. H. Dines, Professor H. Hergesell, and Mr. A. Lawrence Rotch. It was pointed out by Mr. Dines that the novel means of research afforded by flying kites from steamers was not free from many difficulties. Some of these originated from the atmospherical conditions, some from want of sufficient speed in the steamer, others from the structure of the kite. With a speed of 12 knots kites have been raised to 6,600 feet, but with a speed of only eight miles the elevation was restricted to 8,000 feet. Strong and steady winds, and sufficient speed, though so necessary to good altitudes, were seldom obtained simultaneously. Out of 38 ascents only 20 gave good records.

Possibly it is the knowledge of these difficulties with the method of raising kites by artificial wind that induced Professor Hergesell to urge rather the adoption of a permanent kite station on these shores. Efforts are being made to establish such a station in Denmark, and from the beginning of the present year either balloons or kites have been sent up daily from Berlin. The results of these experiments were collected by the International Aëronautical Committee, and published at the expense of the German Government.

Speaking of the important work of the International Aëronautical Committee with ballons sondes, Professor Hergesell stated that the great difficulties had been to find suitable instruments. The greatest altitude so far had been obtained by M. Teisserenc de Bort, but it was expected that still greater heights would be reached by rubber balloons.

While speaking of these rubber ballons sondes it may be of interest to note that at the opening meeting of the new session of the Aëronautical Society of Great Britain will be exhibited one of the first English rubber ballons sondes which have ascended to an altitude of 20,000 metres, and which has been presented to the Society by Mr. P. Y. Alexander.

The remarks made by Mr. T. Lawrence Rotch, the Director of the Blue Hill Observatory, were very corroborative of the yearly-increasing value of kites in meteorological work. It is indeed to this indefatigable worker that we owe the idea of becoming independent of natural wind by using steamers for kite flights. Mr. Rotch exhibited at the meeting most valuable diagrams which embodied the observations obtained from 40 flights during 1900-2. It is important to note that marked inversions in temperature, accompanied by corresponding changes in humidity and wind velocity, were found to occur at all heights, and not only at the greater heights observed by aëronauts. We are told that an investigation of the decrease of temperature obtained in 20 kite flights at Blue Hill up to the extreme height of 13,000 ft., showed that while the mean decrease of temperature, computed by stages of 1,600 ft., was slightly greater in areas of low barometric pressure, there appeared to be no such diminution in the rate. This showed that for heights greater than 13,000 ft., the columns of air might be colder when the pressure at the ground was high than when it was low. In 1901 Mr. Rotch obtained records from the kite meteorograph in ten flights, the average of the highest points attained being 7,870 feet above sea level, and the greatest height being 12,500 feet. Speaking of the kite flights in co-operation with those organised by the International Committee, Mr. Rotch

Digitized by Google

mentioned that these were commenced in December, 1901. In 1902, thirteen flights were made, of which ten were upon the International days specified. In two cases the upper kites broke away, and were lost in the sea. Mr. Rotch estimates the height attained in one of these cases was 16,000 feet. The average height of the flights from which records were obtained was 7,940 feet; the maximum height, 14,000 feet. It was mentioned that the reason why flights were not made on all the International days was lack of wind on the ground, and that failure of the wind at higher levels limited the height reached at considerable altitudes. To raise kites on any day apparatus might be installed on a small steamer in Massachusetts Bay. Mr. Rotch claims that there is an important application for this latter method—the investigation of the meteorological conditions above the trade winds and doldrums. The theories in vogue as to the motion of the upper or anti-trades were not borne out by observations of the movements of volcanic dust and of upper clouds. Knowledge is also wanted concerning the depth of the trades, and about the vertical variations of temperature and humidity over the ocean; whether or no sudden changes in these elements occur between the trades and the anti-trades. It is Mr. Rotch's ambition to make atmospherical soundings with kites between the Azores and Ascension Islands, and for this purpose he is endeavouring to collect the necessary funds to charter and equip a steamer. Such a course would, in his opinion, be productive of the solution of some of the most important problems in meteorology and physical geography.

Regarding the progress made in navigating the air against the wind there was some reference made by Mr. Edward W. Brabrook in his Presidential address to the Section which dealt with Economic Science and Statistics. He stated that experimenters appeared to have advanced little beyond where we were 50 years ago, when, on September 24, 1852, Henri Giffard succeeded in driving a balloon for very short distances against the wind. We wish, indeed, that we could bring forward statistics to show that the advance during the period has been great. But though we must acknowledge the advance to be small, yet it must be pointed out that in the address of the President of the Section of Economic Science the facts of the small advance that has been made are hardly presented as they exist.

M. Henri Giffard, it is true, ascended on the date named in an elongated balloon, carrying steam engine and boiler with inverted chimney. There was, however, considerable wind blowing at the time of his experiment, and he did not attempt even short journeys against the wind, but contented himself with some circular movements and lateral deviations. He did not make a second attempt. The Brothers Tissandier, who next constructed a navigable balloon in 1883, did not attain any very definite result. It was Captains Krebs and Renard, in 1885, who first made definite return journeys against a wind of from 3 to 3·50 metres a second, and who, by means of maps, have recorded their aërial excursions. The history of all scientific progress commences with recorded figures and not on unsubstantiated statements. The history of navigable balloon return journeys must, therefore, start from the efforts of Captains Krebs and Renard, which makes the period of definite work with navigable balloons very considerably less than 50 years. Those who wish to study the actual advances made by M. Santos Dumont in 1901 will find an article on the subject in the last number of this journal.

A glance over the pages of the current number will show how eager modern aëronauts are becoming to eclipse the work of their predecessors in the matter of the navigable balloon, though to so many minds the combination of balloon and motor does not commend itself as the final solution of the problem of Aërial Navigation.

Though progress may be slow, it is the consolation of the aëronautical student to know that to one worker in the days of Giffard there are now hundreds. There

are, too, thousands of precedents that come to his mind to assure him that whether it is to be by the heavier than air, the lighter than air, or the same weight as air, the pressure of combined work and intelligence must one day overthrow the barrier to our knowledge of those laws which govern artificial flight.

The widespread interest now taken in aëronautics and its applications is one reward to the Society which has fostered the growth of the science in this country. At times in the past when there was depression in aëronautical doings, and when there was much scepticism and little encouragement, the Aëronautical Society of Great Britain, even if it only met annually in those times, still in those periodic meetings collected the essence of all real aëronautical progress and preserved it in the old annual reports.

At the present moment the Society may congratulate itself on the steadily growing membership evinced during the last few years, and most especially on the very marked increase of membership during the past session. But with greater interest in the subject comes wider scope of action, and consequently need of ampler funds wherewith to carry out our projects and ambitions. It is, therefore, desirable in the future to still further enlarge our membership. Increase of membership in every society must largely depend on the hearty co-operation of each individual member, who can put before his friends the advantages of such a society and the greater privileges that will ensue from an increased membership. That there is such a unity of action betwixt the members of the Aëronautical Society of Great Britain is evident from the many names of candidates proposed by the members. But to still further meet the needs of aëronautical developments let us unite again in the useful task, and before the thirty-ninth session has ended and we have taken upon ourselves the weight of forty years, let us have doubled even the last year's record of new membership!

The de Bradsky Airship.

A Short Account of its Development, and of the Causes that led to the Accident on October 13th, 1902.

By Baron v. Schnkider.

By kind permission of Baron de Bradsky's widow, I am enabled to give an authentic account of his ideas concerning the "de Bradsky" balloon, of its construction, and of the causes that produced the lamentable accident on October 13th, 1902, in which Baron de Bradsky (Fig. 1) [to the left] and his engineer, Morin [to the right], lost their lives. Baroness de Bradsky thought it due to her husband's memory to have this account published, particularly as the details in the papers at the time of the accident were more or less incorrect, and none of their authors had grasped the fundamental idea which actuated Baron de Bradsky in the construction of his airship; Baroness de Bradsky was also of the opinion that a reliable account would be of interest to aëronauts in general, and might be of use in solving the numerous and difficult problems which assail them. Santos-Dumont's experiments had convinced the inventor that *this* system of airship was well-nigh perfect in its way, while at the same time raising doubts in his mind as to its being altogether the best. After carefully studying all his forerunners, investigations and experiments, he came to the conclusion that an airship in the real sense of the term ought to *raise itself* in the air by means of propellers with as little as possible aid from a balloon, and that one would gradually be enabled to dispense with the latter. His investigations were therefore directed in the following manner:—

1. To study the different sorts of propellers hitherto in use, and test their power of raising a balloon or any given weight. 2. To construct if necessary a new type of propeller, specially suited to the purpose in view. 3. To test the equilibrium of a balloon when raised in such a manner.

After some preliminary investigations as to the best shape for the balloon and the most reliable way of preventing deformation, the ordinary cigar-shape, *i.e.*, pointed at the prow but rounded at the helm, was adopted, with a wooden framework extending the whole length of the balloon, at one end of which the rudder was attached; this frame also supported the

Digitized by Google

car by means of wires or ropes, and just above it were fixed a pair of long fins, which could also be regulated from the car, and were intended to act as a parachute (Fig. 2.)

A balloon of this type was ordered from M. H. Lachambre, of Paris, in April, 1901, to be made of Japanese silk, and shortly after the design for a car 23 yds. long from Messrs. Risacher and Hebert; the capacity of the balloon was such as to bear two persons besides the driving machinery.

While these orders were being executed, the inventor began his trials with propellers. With.

This type of propeller is generally built with two blades; however, de Bradsky also tried a greater number with marked success, as the following table of results indicates:—

Table of Results with Buttenstaedt propeller.

Diameter of blades, 2.62 *yds.*

No. of Blades.	No. of Revol.	Weight raised.	Angle to axis of rotation.
2	442	72·6 lbs.	45 deg.
3	420	96·8 ,,	45 ,,
4	326	68·2 ,,	45 ,,
4	340	72·6 ,,	45 ,,
4	358	79·2 ,,	45 ,,



Baron de Bradsky.—M. Morin.

Fig. 1.—**The De Brasky Airship.**

out denying a certain measure of success to Santos-Dumont's propeller (Fig. 3), which has also been used by Count Zeppelin, the inventor thought that opinion was too much divided as to its most favourable proportions, as, in fact, the design employed by Count Zeppelin met with much criticism in France, while giving very good results. He accordingly first of all tried the so-called Buttenstaedt propeller, in combination with a 16 h.p. Buchet motor, the latter being fastened on a flying scaffold and the propeller fixed to a flywheel.

4	310	96·8 lbs.	22 deg.
6	190	55·0 ,,	45 ,,
6	224	59·4 ,,	45 ,,
6	276	74·8 ,,	45 ,,
6	350	90·2 ,,	45 ,,
6	164	63·8 ,,	22·5 ,,
6	214	85·8 ,,	22·5 ,,
6	260	107·8 ,,	22·5 ,,
6	284	110·0 ,,	22·5 ,,
8	156	55·0 ,,	45 ,,

From these results, it is evident that the best effect was produced by a 6-bladed propeller in which the separate blades were placed at an

Digitized by Google

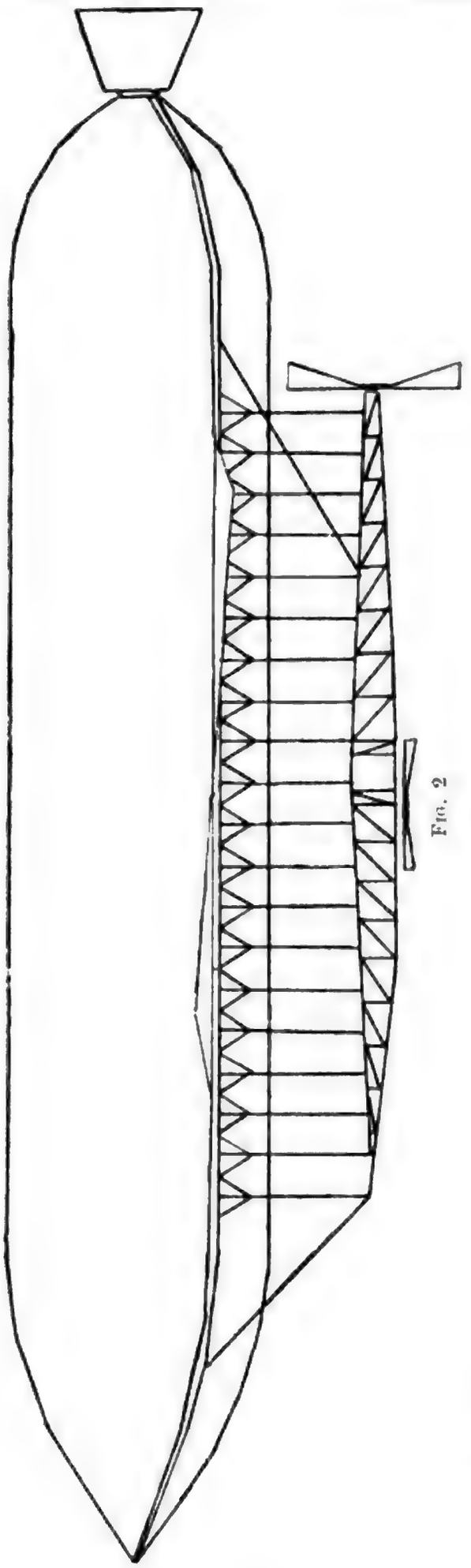


FIG. 2

angle of 22·5 deg. to the plane of rotation. This induced the inventor to make some further trials with a sort of combination of the Santos-Dumont and Buttenstaedt propeller, which, however, were superseded by later investigations.

This work had proceeded so far when M. H. Lachambre was able to hand over the balloon to him (in the autumn of 1901), and Messrs. Risacher and Hebert produced the car. The former was immediately filled with gas and attached to the car, as the inventor was anxious to test them both, when, much to his regret, it appeared to him that the car was very badly made and utterly useless. The balloon, therefore, had to be stowed away for the winter, and further trials postponed to the spring.

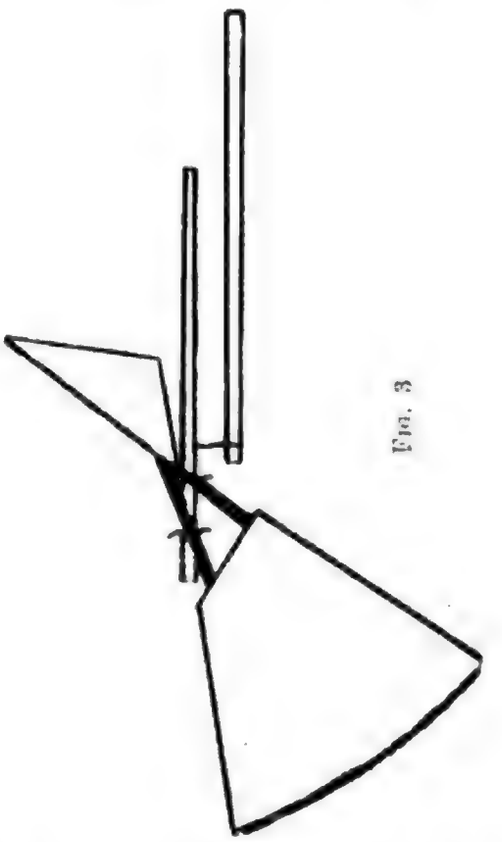


FIG. 3

This enforced delay led the inventor to make some further experiments with propellers, and to develop an idea which had been growing on his mind. He had become convinced of the desirability of imitating the shape of a bird's wing in constructing the blades of propellers, instead of copying, to a certain extent, fishes' fins, as had hitherto been done. Birds' wings, however, are broadest at their base, whereas he constructed his blades widest at a point we will call the shock-centre, through which the resultant of the various forces acting on different points of the blade, as it turns, passes.

The subjoined illustrations (Figs. 4 and 5) and the photograph (Fig. 6) will explain his idea. Each propeller has two blades like Fig. 4 fixed on to the propeller-shaft, and composed of two

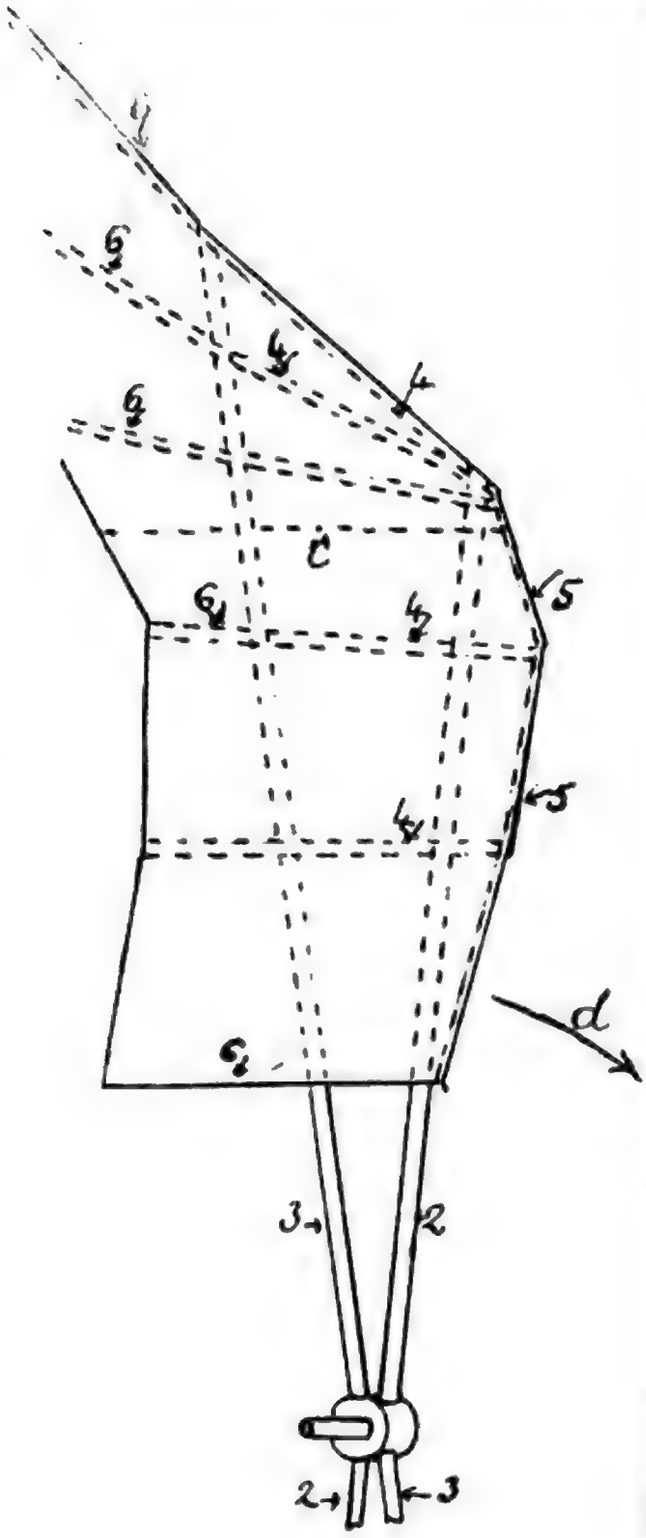


Fig. 4.

straight tubes (2 and 3) at an angle (a) of about 20 deg. to the plane of rotation (x). On these tubes are fixed cross pieces (4), and united to these the tubes (5), 2, 3, 4, and 5 represent the *flat* surface of the blade and are rigid. The *flexible* part of the blade is composed of elastic rods (6), attached to the cross pieces (4), and forming when the blade is at rest an angle of about 40 deg. with the plane of the flat surface, and an angle of 60 deg. with the plane of rotation (x). The whole frame was covered with varnished silk, and it is easy to understand from the diagrams that when the blades rotated in the direction of the arrow (d), the angle (b) would diminish, and the curved part of the blade get flattened out.

In the spring of 1902, de Bradsky resumed his work in the shed where the balloon had been put up for the winter, and began by re-examining the state of the car. This seemed to him to have been so badly constructed that he decided to cut it up, and have it rebuilt by his own engineer, Morin.

Meanwhile, he had it repaired to a certain extent in order to test the new propellers, with which he obtained a raising power of 242 lbs. with blades of 4 yds. diameter and 198 lbs.

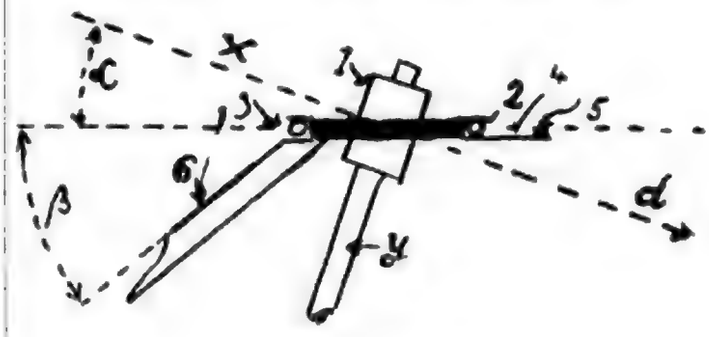


Fig. 5.

with blades of 2·62 yds. diameter at about 850 revolutions a minute; this was all the Buchet motor mentioned above could produce and pecuniary reasons restrained the inventor from getting a more powerful one. After testing the propellers, the inventor had the car cut up and reconstructed by his engineer, Morin. The frame for the aëronauts and motor was connected by steel tubes, and braced with wires and made rectangular in shape, terminating on each side in a triangular section; it was 19·14 yds. long, and rested on four feet in order to protect the horizontal screw underneath.

The motor drove two screws, a horizontal one and a vertical one, each of which had a clutch by which it was thrown on or off. The horizontal screw was placed under the car and intended to *raise* the latter and the balloon, but the vertical screw was fixed at the end of the car and propelled the latter in a horizontal direction; it is particularly important to note

Digitized by Google

that the screws were always used singly, and never at the same time.

The subjoined photograph (Fig. 7) shows the position of the motor in the car; to the left is the gasoline tank, and to the right the radiating tube and water reservoir. One great improvement was the arrangement of muffling tubes into which the exhaust gases escaped from the cylinders, and which consisted of sheet-iron tubes pierced with a number of small holes, as may be seen from the photograph; this arrangement radically prevented the flames of the exhaust gases from igniting any escaping hydrogen from the balloon on the principle o the Davy safety lamp.

Special care was also devoted to the connection of the gasoline reservoir with the motor, this tube consisting of a particular sort of flexible rubber (Durit), as it is highly probable that the destruction of Severo's airship, "Pax," was due to the fracture of the *rigid* tube connecting these parts.

The electric battery and spark-break were also carefully enclosed to prevent accidents arising from that quarter.

As soon as the reconstruction of the car and fittin it up with machinery was fairly completed, the inventor turned his attention to the balloon again, which, in the interval, had been fitted up with two partitions inside by M. Lachambre in order to prevent the so-called "rolling" of the gas. On weighing the silken covering he found, however, that the weight had increased from 275 lbs. to 396 lbs.; this necessitated enlarging the balloon by a strip of silk about 1 yard wide, which increased its capacity from 27,181 cb. ft. to 30,005 cb. ft.

De Bradsky next proceeded to fill it with hydrogen, beginning on September 22, 1902. For this purpose the balloon, which had a length of 37 yds., was brought into Severo's shed. As soon as the upper part had expanded under the influence of the gas, the framework mentioned on page 8 was attached to it, and the long fins, also referred to there, were fastened to it. The frame also served to fasten 50 ends of rope fixed crosswise, which communicated with the wires of the car.

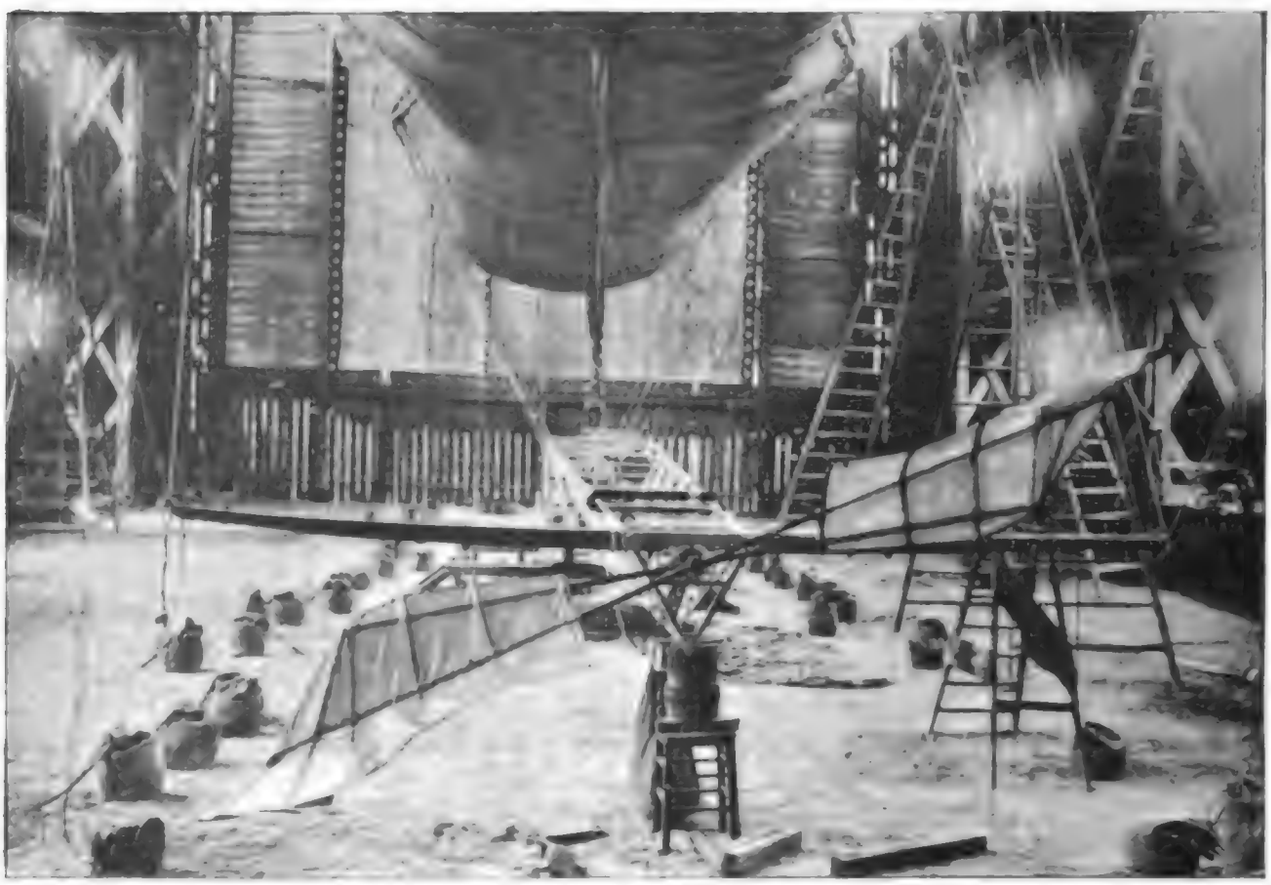


Fig. 6.

After filling the balloon completely with hydrogen, the inventor began attaching the car to it, when he discovered that, owing to some change in the balloon's equilibrium, it got out of shape. This induced him to lengthen the car by 2·73 yds. to 22 yds. instead of 19·14 yds.,

Digitized by Google

which enabled him to gain a number of new points of contact between the balloon and car, besides fastening them together by means of ropes. In addition to these a hawser of 65·6 yds. was suspended as a guide rope from the prow of the balloon and one of 44 yds. to the same end of the car.

In calculating the size of the balloon, a raising power of 36·96 oz. for every 1·308 cb. yd. was provided for. The size of the balloon was 30,005 cb. ft. and the weight of the whole air-ship as follows :—

Car, motor, and driving machinery ..	809·6 lbs.
Two oil-reservoirs..	41·8 ,,
Water and gasoline	39·6 ,,
Silk covering and valves..	418·0 ,,
Wooden frame	132·0 ,,
Fins	33·0 ,,
Rudder	8·8 ,,
Suspending wires	13·2 ,,
Aëronauts	308·0 ,,
Hawsers and other ropes..	110·0 ,,
Supports of the car	8·8 ,,
	1922·8 lbs.

The total weight being 1922·8 lbs., there remained a raising power of 39·6 lbs.

De Bradsky thought it a great advantage to have this extra raising power, as it enabled him to add a certain amount of ballast and to test the efficiency of the horizontal screw thereby. Accordingly he added 187 lbs. of ballast, which was distributed about the car, and then started the horizontal screw; under its action the balloon rose at the rate of half-a-yard per second to the height of 6·5 yds., when it had to be arrested to prevent it striking against the roof of the shed.

This success proved that the horizontal screw was capable of raising an over-weight in a most satisfactory manner, and the best results were anticipated when the balloon was brought into the open-air. This, however, had to be postponed till October 13, 1902, owing to bad weather.

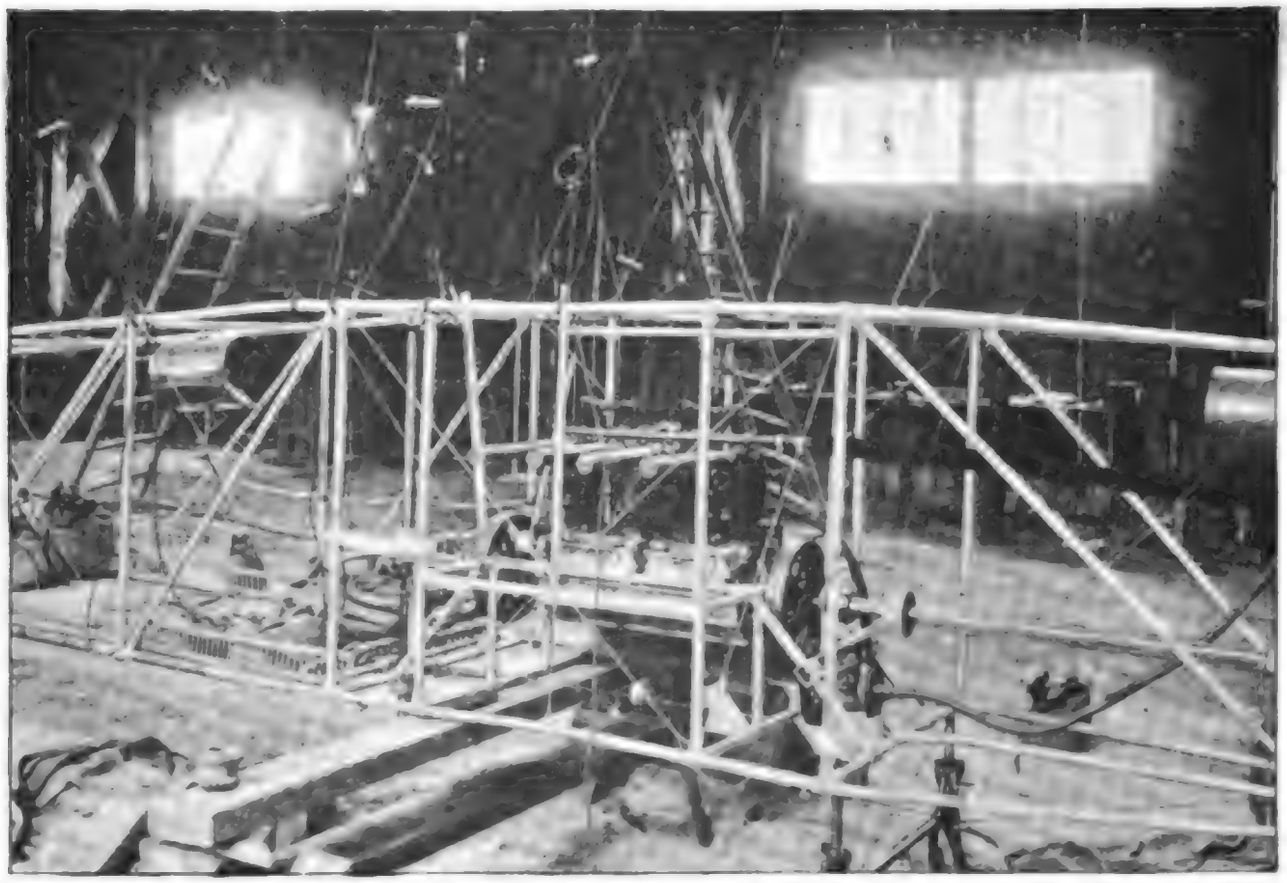


Fig. 7.

THE FATAL 13TH OCTOBER.

The weather having improved, the inventor started early for Vaugirard, where the air-ship was on that morning, and met his engineer, Morin, superintending the refilling with gas to make up for waste. On weighing the air-ship it appeared that there was a raising power of 66 lbs. To compensate this, 66 lbs. of sand in two bags were taken in

the car, and besides this 198 lbs. in six bags and 17·6 pints of petroleum, making a total over-weight of 209 lbs. The balloon being already in the open air, they then started the horizontal screw, which caused it to ascend, its movements being further accelerated by throwing out two sandbags, and then the men below let go the hawsers, and the fatal voyage began. The inventor's wife had followed him to Vaugirard, where she saw him alive for the last time.

After ascending about 160 yds. the horizontal screw was stopped, and the vertical screw started; this induced the air-ship to move *forward*, but unfortunately the rudder was not powerful enough to keep it *against* the wind, because the rounded prow of the balloon hindered its action. In consequence, it appeared that the aëronauts, after making some vain attempts to get it to fly *against* the wind, had to let it drift with the wind over the City and in the direction of the Montmartre.

The ascent had hitherto proved that with the exception of the faulty rudder, de Bradsky's system of raising an over-weight by means of a vertical screw, and after attaining a certain elevation using a horizontal screw to move forward in a given direction, was a good idea; his wife, therefore, who was watching the transit, had no misgivings as to a favourable termination, especially as she heard the balloon had traversed Paris in a satisfactory manner.

Unfortunately, however, neither the aëronauts nor any of their friends had sufficiently considered a very important factor, which, as the issue showed, was one of the main causes of the catastrophe. Using a *horizontal* screw under the airship in order to raise the latter undoubtedly produced the desired effect, but at the same time it induced a *rotary* motion of the airship, and accordingly a torsional strain on the suspending wires; this strain would, of course, be all the more detrimental according to the resistance of the balloon to this rotary motion, and the violence of the wind.

The inventor had guarded against this fault to a certain extent by arranging that the steel wires which fastened the car to the balloon should end in pieces of rope, so that any torsional strain should affect the *ropes* and not the wires. This, however, does not seem to have been a sufficient safeguard. In addition, one of his workmen had fastened the wires with a *sharp* pair of tweezers, so that they were all indented, and the majority gave way just at these places.

When the balloon reached the neighbourhood of Globe de Stains, the aeronauts shouted to a carpenter below, a M. Aubert, who was watching them, asking him where they were, and in what direction they were flying? They then started the horizontal screw again and passed over a railway embankment. The next thing M. Aubert saw was Morin moving across to de Bradsky, and the airship tipping up in front, immediately the overstrained wires snapped and the car fell heavily to the ground, while the balloon rose with great rapidity and soon disappeared.

On approaching the scene of the disaster M. Aubert found both the aeronauts dead and entangled in the *débris* of the car. He had them removed by his workmen, and sent for the Prefect of Police, who saw them conveyed to their respective residences.

The causes of this sad event may be briefly summed up as follows:—

1. The *inefficiency* of the rudder, which prevented the aeronauts from going in any *premeditated* direction, and, in particular, not towards Issy les Moulineaux, where the manœuvring grounds afforded ample space for all sorts of evolutions, instead of drifting over the City as they did.

2. The *torsional* strain on the wires.

3. The *weakness* of the latter and their having been operated on with sharp tweezers.

4. The neglect on the part of the aeronauts to use the *valves* when they wished to descend; an effective use of the latter might certainly have prevented the accident at the last moment.

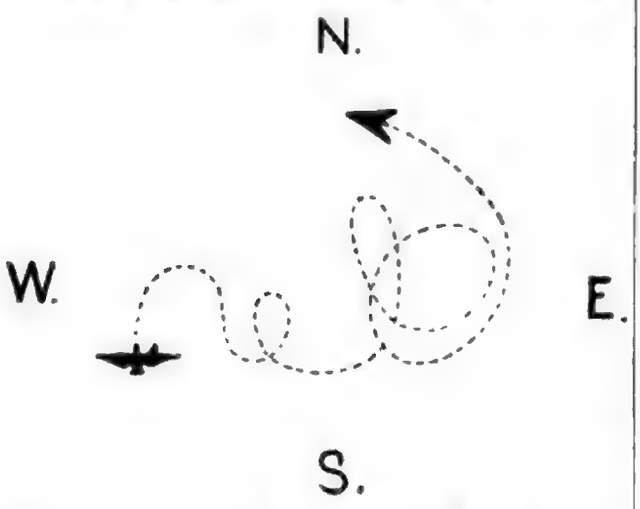
The Sailing Flight of the Turkey-Buzzard.

By T. H. Hugo.

The central plain of Mexico is at a considerable elevation, ranging from 3,000 ft. at the frontier to 7,300 in the immediate neighbourhood of the City of Mexico. The air is, consequently, considerably rarefied, and one would suppose that birds would find it difficult to practise sailing and circling flight; but that does not seem to be the case, as, at any time during the day, numbers of turkey-buzzards can be seen sailing or floating and circling with only a rare flap of wing; and, as a proof that rarety of atmosphere does not seem to diminish their sailing powers, I have seen at Tres Marias, a station on the Cuernavaca line, as it crosses the hills bounding the southern limit of the plain, at an elevation of over 10,000, these birds sailing equally gracefully and without any appearance of labour. There

Digitized by Google

can be little doubt that the air at this elevation has less supporting power, and, therefore, it must be compensated for by the greater speed of the upward current, and shows how wonderfully adapted the wing of the turkey-buzzard is for sailing flight, and that at a lower elevation the wing could support more than the weight of the bird. Living mostly on carrion, it is known that they sometimes gorge themselves to such an extent that they can hardly fly, and it is, possibly, to provide their escape at such times that they are so well endowed with power of flight. The temperature over the plain increases till after mid-day, and up to that time there is rarely a breeze except for a fitful puff now and then; constant whirls of air are to be seen revolving, sometimes from right to left, other times in a contrary direction, spinning across the plain, and when crossing a road or ploughed field, carrying dust or leaves torn from the dried corn stalks to heights varying from 20 to perhaps 100 ft. Commencing with narrow and very rapid motion



the whirl broadens as it rises, till it loses the power to carry further the dried corn blades and withered grass, which return to the ground with many oscillations. The air, heated by contact with the sun-scorched plain, is rising, and this, perhaps, is the best time to study the sailing powers of the turkey-buzzard, when many are to be seen floating over the fields at all heights, and when low, generally with wings much elevated, and this in an atmosphere which, to the senses, appears an oppressive calm. During these hours they give one the impression that they float about much as a cork does on a wave, that it requires no ingenuity. There is none of that constant adapting the wing to the varying pulses of air that is seen later on when the breeze springs up; but with wings constantly outstretched, the impression is of rest, not of toil, so graceful and so uniform is the motion. Sometimes they will seek the shade of a cactus, where they lie with bill open, giving the opportunity of seeing them alight, and it is evident that to do so requires exertion, as with wings right over their backs they sink but slowly, and sometimes, as if impatient with their slow progress downwards, they lower their wings and close them. This manœuvre always filled me with envy, the difficulty being to descend. Between 12 and 1 a breeze springs up, generally, and continues till 4 or 5; at times the wind increases to a half gale, but the buzzards do not cease sailing about, though, generally, at a higher elevation. Rocking in the fresh breeze they hold the wings in quite a different manner; these are much arched, not lying horizontally but with a varying angle to the wind and the primaries sharply bent upwards, and there is a constant adjustment to the force and direction of the wind waves. I was anxious to settle the question, *i.e.*, "the path of the current striking a sailing wing," which I had formerly tried to solve by causing smoke to be borne by the wind against a dried wing. The smoke seemed to sweep over the upper surface, leaving it before reaching the last row of coverts, and had an inclination to curl towards the tip of the wing; on striking the under surface it had the tendency to be swept towards the shoulder. I expected that if the current ran along the under surface from primaries to shoulder, it escaped by raising the feathers adjoining the body, which are very weak; and to get a close under view of the birds, I have lain down in an open spot, which seemed to attract the buzzards, and they have sailed over me at a not greater height, perhaps, than 10 ft., viewing me intently, but I could detect neither a raising or vibration of these feathers; the wing looked as solid as if cast in bronze. These vultures are often to be seen circling in great spirals, and at times the lower half going from right to left, while the upper half were circling in a contrary direction, and they do not seem to be influenced by the direction of the whirls of air, as, on February 9th, I made the following note (and re-marked it several times afterwards): "11 a.m., wind very light, south-easterly, birds circling from right to left, the majority of whirls in a contrary direction." The path of the circling bird is complicated, and having traced it several times I give the following as an example: I timed the periods that I have observed the turkey-buzzard sail without flap of wing to be 4, 5, and 10 minutes on different occasions, and then it was not that the birds

Digitized by Google

commenced to flap, but that they had been carried out of my view by rounding the side of a hill or floating away over the plain. Nothing strikes one so forcibly in watching these birds as the ease they evince, the absence of all apparent exertion, and one must believe that it does not demand much muscular power, perhaps not much more than in keeping one's arm fully supported by lying on a desk or table, outstretched. In a climate like Mexico, and the favourable atmospheric conditions found there, *i.e.*, the regularity of a large mass of air rising, one would be led to think that with a properly constructed surface, persistence, and a stout heart to learn sailing, flight might be looked upon as a possibility.

New British Airships.

We are indebted to the inventors of the two airships of British make now attracting attention for the following details of their construction:—

1.—The Spencer Airship.

In form the airship consists of a fusiform gas-vessel supporting a triangular braced keel or framework which contains the motor, mechanism, and voyagers.

The gas vessel is 93 feet long and 24 feet maximum diameter, and has a capacity of 30,000 cubic feet.

It is made of the closely-woven silken fabric used for Messrs. Spencer's ordinary Passenger Balloons, varnished several times inside and outside to render it impervious to hydrogen gas. It is fitted with a "ripping valve," by means of which the gas may be speedily released, inlet tubes (for inflating it with hydrogen and for pumping in air), and an automatic valve which relieves any undue pressure before the bursting point of the fabric is reached. Running horizontally round the gas vessel, and securely fixed to it, is a sailcloth band which supports the pendant weight. This horizontal band also forms a safeguard by assuring that the gas vessel shall take the form of a parachute in any contingency.

The framework or keel hangs 12 feet below the gas vessel, is of bamboo construction, stayed with steel wires, and measures 50 feet long.

It carries in front the 12-foot diameter screw propeller or "tractor" on a steel shaft which is supported by ball bearings and runs through gear-wheels and a clutch to the motor.

The Simms petrol motor is situated in the forward part of the framework, and is of 24 h.-p. It is fitted with magneto ignition, has 4 cylinders, mechanically operated inlet valves and throttle governor. It develops its power when running at a speed of 1,050 revolutions, and this speed is reduced by the gearing to 300 revolutions per minute, at which the "tractor" revolves.

The exhaust box of the engine is covered with wire gauze, on the Davy Safety Lamp principle, to guard against ignition should any gas fumes approach it.

Situated centrally on the framework are two brass containers, the first of which holds the water for cooling the engine, which is caused to circulate through a radiator and over the cylinders by means of a centrifugal pump working on the flywheel; and the second the five gallons of petrol which forms the fuel for the motor.

In the rear part of the framework is the car, in which the aëronaut takes his position and from which he has control of the motor and the clutch by means of levers actuating wires on the E. M. Bowden's patent system. He also has ropes from the rudder (which is suspended at the rear end of the framework), which enable him thereby to direct the course of the airship to the right or left as desired. He can vary the altitude in two manners: first, by means of a balance rope, which enables him to point the airship upwards or downwards, according to whether it is desired to proceed higher or lower; and secondly, by means of a hand-blower, which enables him to pump air into the gas container, and thus cause it to descend by the increase of its specific gravity.

Ballast is also carried to enable a higher altitude to be reached if desired.

2.—Dr. Barton's Airship.

Dimensions of Shed.—75 ft. high, 55 ft. wide, 182 ft. long.

Details of Airship.—The balloon is made of Tussore silk, 170ft. long, 40ft. diameter. The major part of the balloon is cylindrical in formation, the nose being ogeve, the stern slightly spherical. It is divided into three compartments by flexible diaphragms; the total capacity —230,000 cubic feet. In the centre compartment is an internal air-ballonet, capable of being expanded to 17,000 cubic ft. The balloon is fitted with three automatic and four voluntary valves; the outer covering is made of unvarnished Tussore silk, strengthened every nine inches by webbing bands. The nose of the balloon is also strengthened by bamboos radiating from the centre. These are contained

Digitized by Google

in double seams in the outer covering. There is also a split bamboo, 2½ inches wide running completely round the Equator of the balloon.

The leading lines are made of tanned Italian hemp, from the edge of the outer covering to the upper longitudinal aëroplane frame, and are placed at intervals of every 18 inches. From that to the keel there is a wire cable, the latter being collected in the shape of a fan, so as to pass under the crutch of each of the large bamboos which form the main triangles of the car.

Dimensions of Ship.

Length from bow to end of rudder ...	140 ft.
Height of bamboo framework ...	18 ,,
Width	16½ ,,
Length of deck	133 ,,
Width of deck	7 ,,
Width of flying-bridges	15 in.
Height of hand-rail ...	4 ft. above deck.
Total height (from keel to top of balloon)	60 ft.
Width of aëroplane frames ...	30 ,,

Number of aëroplanes—30 (arranged in three series in front of each of the three motors, five on each side of the flying-bridge.)

Dimensions of each aëroplane—13 ft. 6 in. × 3 ft.

Engines.—Three in number, 50-horse power each, Buchet petrol motors, electric ignition, automatically governed; 1,600 revolutions per minute (can be accelerated up to 1,800), fitted with Longuemare carburettor, and silencer fitted with diaphragms, and covered with two layers of Davy gauze. The engines are cooled by means of Clarkson radiators, the pump for circulating water being of Panhard type, driven off the flywheel.

Drive.—Clutch, pinion, two-toothed wheels, two belt-pulleys, belt to two corresponding belt-pulleys on steel propeller shaft, reducing revolutions of propeller to 250 per minute.

Weight of Motor	305 lbs.
Fly-wheel	112 ,,
Weight of gearing	500 ,,
Weight of each propeller and shaft	260 ,,

Propellers.—Six in number, arranged laterally, one on each side of each motor, which work independently. The propellers are Mangin type, six blades each, 12 ft. in diameter.

Estimated thrust—3,000 lbs., peripheral speed of propeller, 1½ miles per minute.

Balancing Apparatus.—Two water tanks, capable of holding 50 gallons each, are placed on the extreme bow and stern of the deck. These are connected by pipes to a motor-driven centrifugal pump, which can be governed either by hand or automatically by the Barton-Walker electrical equipoise.

The rudder is 20 ft. high × 12 ft. long, and is on the balanced principle, being pivoted 2/5ths from the front edge.

The rudder and propellers are made of tubular steel, covered with a double layer of strong varnished fabric.

The helmsman is in telegraphic communication, on the Bowden-Brake principle, with each of the motor engineers.

The crew will consist of seven—three engineers, helmsman, aëronaut, balancing-pump engineer, and captain.

Total Estimated Weight of airship, crew, water, petrol, &c.—15,700 lbs. (approximately, tons.)

The St. Louis Exhibition.

The Aëronautical Society of Great Britain has received from the Royal Commission particulars concerning the classes of aëronautical exhibits—(Group 77).

Aërial navigation will form a portion of the department which deals with transportation (Department G).

Class 481:—Balloon construction; fabrics, varnishes, cars, valves, netting, cordage, appliances for stopping balloons, anchors, grapnels, generation of hydrogen, and of other light gases. Captive balloons.

Class 482:—Aërial voyages: use of balloons for the study of the atmosphere, air currents, clouds, temperature at great height, optical phenomena, etc., drawings, maps of journeys, diagrams, photographs.

Class 483:—Military ballooning; military captive balloons and their accessories, winding drums, transport waggons, apparatus for inflation.

Class 484:—Aërial navigation; dirigible balloons and guiding apparatus, flying machines, screw propellers, aëroplanes, and parachutes.

The Society has also received the supplementary rules relating to aëronautic competitions, issued August, 1903. These deal with additional prizes for balloon contests, and are as follows:—

In addition to the prizes heretofore announced for the Aëronautic Competition, the Universal Exposition offers the following prizes, open to all approved competitors, for a series of ten contests or balloon races between

Digitized by Google

mounted spherical balloons, to take place during the Exposition.

(a) Such contests shall take place on the first and third Monday of each month, beginning May, 1904. Additional or postponed races may take place in October.

(b) Such contests shall start from the Exposition grounds, and the prizes for the races will be awarded to the aëronauts landing nearest to a designated goal to be selected by the judges a short time before the start is made, in view of the then prevailing wind, and at a distance of 20 to 30 miles.

(c) The race prizes shall be as follows:—

1st prize—$200, and a silver gilt medal.
2nd prize—$100, and a silver medal.
3rd prize—$50, and a bronze medal.

These shall apply to each race, as hereinafter limited. For the whole series of ten or more contests there will be in addition:—

One 1st prize $50 for the best report of a voyage.
One 2nd prize $25 for the next best report.
One 1st prize $50 and one 2nd prize $25 for the first and second best set of photographs taken in such voyages.

The reports and photographs to remain the property of the Exposition, and to be exhibited.

(d) When ten or more aëronauts participate in such a race, all three prizes shall be awarded. When six participate, only the first two prizes shall be awarded, and when only three participate, only the first prize shall be awarded. If less than three competitors present themselves, the judges may postpone or suppress the contest. When more than ten competitors present themselves, the judges may divide them into two sections, and require one of these to compete on a subsequent day, on which occasion it will be entitled to prizes.

(e) The Exposition management will furnish, free of charge, a shed, closed on three sides, to be 100 feet long, 80 feet wide, and 80 feet high, to store, test, examine, and repair the balloons of the contestants. It will be provided with suitable workshops, laboratories, and storage rooms. An expert will also be in attendance, to make repairs at a schedule of prices to be fixed by the management.

(f) The Exposition management will furnish, free of charge, suitable coal-gas to inflate the balloons, and sand to serve as ballast. It will also reimburse the actual reasonable expenses of the contestants back from the designated goal to the Exposition grounds, and it will protect the foreign contestants against any Customs charges upon their material for landing outside of the Exposition grounds.

(g) The contestants will be free to carry passengers, but the return expenses of the latter will not be paid by the Exposition.

In order to equalize conditions between balloons of different sizes, each will be handicapped in the amount of ballast which may be spent in reaching the goal. Such handicap shall be at the rate of 15 pounds per 1,000 cubic feet of the capacity of the balloon. This shall be delivered to the contestant in unsealed bags. The balance of the ballast required to equilibrate the balloon, while leaving it sufficient ascending power to depart, under the wind conditions then prevailing, shall be delivered to the contestant in sealed bags, to be brought back and returned by him in like condition. The judges will prescribe proper safeguards to prevent evasions of this rule.

(h) The sufficient strength and condition of each of the balloons shall be established in advance by the judges, who will in the main apply the rules and methods formulated for the Aëronautical contests at the French Exposition of 1900. The judges may rule out such of the balloons as do not comply with such conditions, but from their decision appeal may be taken to the International Jury, from whose decision there shall be no appeal.

(i) The judges will draw up rules to govern the details of these contests. They may, in consultation with the contestants, modify the conditions for some of these races, such as substituting the longest distance travelled—in, say, two hours—for the landing nearest to a designated goal; availing of contrary air currents to return nearest to the Exposition grounds, etc., etc. Races may be postponed or suppressed in case of bad weather, and additional prizes may be awarded by the judges in case of very meritorious performances.

(j) The prize in Section IV. of the Rules and regulations heretofore issued, viz:—

"(a) For the greatest altitude attained, starting from the Exposition grounds."

is hereby withdrawn, upon representations from foreign aëronauts that the performance is too hazardous.

The Lebaudy Airship.

By the kind permission of the editor of the *Illustrated Scientific News* we are able to reprint some views of the Lebaudy airship, to which we have already referred in this journal. In the September number of the *Illustrated Scientific News* will be found a descriptive

article on the Lebaudy navigable balloon, from the pen of Major B. Baden-Powell, to which readers of this journal may well refer. In the opinion of the writer the Lebaudy airship is "probably the most successful aërial machine ever made." It is distinctly original in many important details. The balloon, which has a gas capacity of 80,000 cubic feet, like its predecessors, is elongated, being pointed at both ends. The long frame-work supporting machinery and car, conspicuous in the constructions of M. Santos Dumont and others, is, however, abolished. The lower surface of the balloon is flat, and there is a frame of steel tubing surrounding this portion. The car is a steel frame partly covered with canvas, and is in the form of a boat. This is attached to the gas envelope by steel wire ropes. From the steel frame surrounding the flat bottom of the balloon six steel tubes run diagonally down to the car to convey the thrust of the propellers to the balloon. The engine is 40-horse power. The propellers are small, being only 2.44 m. in diameter, but they rotate at the high speed of 1,000 turns per minute. They each consist of a steel bar to which is fixed a thin plate of steel of a width equal to 1-10th of the circumference.

In reference to the construction of this airship Major Baden-Powell mentions that it is surprising how strongly and solidly the parts of the airship are made. Nothing is made of aluminium, steel being exclusively employed.

It is stated that the airship has already made twenty-nine journeys, twenty-eight of which have been return ones.



By permission of] **The Lebaudy Shed.** *["Illustrated Scientific News."]*

NOTES.

Cross-Sea Ballooning.— In the *Yachting World* Mr. Griffith Brewer has lately proposed a scheme for enabling a balloon travelling over the sea to be steered to the right or left from the direction of travel of the wind. He proposes that there should be a float somewhat in the form of a Whitehead torpedo to be immersed in the water and drawn behind the balloon by means of a rope. He thinks that such a float could be controlled from the car of a balloon by the use of electrically operated steering gear, which could be actuated through a twin insulated cable by an electric current from the car. The float would be provided with radially projecting plates or fins extending longitudinally for the purpose of preventing lateral slip when being directed to the right or left, and it would drag the balloon away from the direct line of travel of the wind.

Mr. Brewer has made two preliminary experiments with a small captive balloon of 500 cubic feet capacity, with which, on a second occasion, he succeeded in towing a sailing canoe up the circuitous course of the Thames from Teddington Weir to Long Ditton, a distance of four miles. The only means of steering the balloon was the rudder on the canoe.

The Aëronautical Exhibits in the Meteorological Exhibition at the Southport Meeting of the British Association.— In connection with the meeting of the International Meteorological Committee at the meeting of the British Associa-

Digitized by Google

tion at Southport, there was an excellent exhibition of instruments connected with meteorology and terrestrial magnetism. No meteorological exhibition could be called complete at the present time if it did not contain some representation of the modern methods of investigating the upper air by kites and ballons-sondes. The organisers of the Southport Exhibition had, however, taken care that there should be no such omission. Mr. A. Lawrence Rotch exhibited photographs of kites and apparatus used at Blue Hill Observatory since 1894 for exploring the air, drawings showing details of kites and of the meteorographs carried by them now in use at Blue Hill, and a diagram showing the changes in the meteorological elements with height during 45 kite ascents, 1900-02.

Mr. W. H. Dines exhibited charts obtained from self-recording instruments sent up by means of kites at Crinan, N.B., in July and August, 1902.

Dr. W. Mansergh Varley exhibited for Mr. P. Y. Alexander apparatus used for ballons-sondes experiments:—

1. The smaller of a pair of india-rubber balloons used for the ascent from Bath on July 2, 1903. This balloon landed at Alfreton, in Derbyshire, five hours later, having been to a height of over 20,000 metres.

2. Two new rubber balloons similar to those used in the ascents from Bath, made by the Continental Gutta-Percha Company of Hanover.

3. Barothermograph for sounding balloon work, of Professor Hugessell's pattern, made by Bosch, of Strasburg.

This instrument has already made two ascents from Bath, the first on July 2, when it fell at Alfreton, Derbyshire, having travelled 126 miles in five hours, and attained a height of over 20,000 metres, and the second on August 6, when it fell at Eecke, on the Franco-Belgian frontier, having travelled 229 miles in three hours, and attained a height of 13,700 metres.

4. Record obtained for the ascent from Bath on June 4, 1903. The balloon fell in the sea and the records are somewhat damaged by water.

5. Record obtained for the ascent from Bath on July 2, 1903.

6. Record obtained for the ascent from Bath on August 6, 1903.

Messrs. Newton and Co. contributed an altimeter for registering the height to which kites and other aërial machines ascend.

Mr. Stanley Spencer's recent Navigable Balloon Journey.—Mr. Stanley Spencer recently attempted to round the dome of St. Paul's Cathedral in the navigable balloon which is described in full in another part of this journal, but, owing to the meteorological conditions, could not carry out his programme, which had attracted thousands to the roofs in the neighbourhood of the dome. The failure was an object-lesson in the present limits of the system, which combines motors and propellers with a bag of gas that is lighter than air. On the occasion of Mr. Stanley Spencer's recent attempt he left the Palace grounds about 5 p.m. and reached St. Paul's in half an hour, but when he attempted to round the dome the wind-force overcame the propellers, and in vain did he try to demonstrate the steering powers of his machine. Mr. Stanley Spencer may, however, be congratulated on his continued efforts to show that the British nation does not intend to be behindhand in the matter of navigable balloons, and it must always be remembered that he has been the first man in this country to journey in a balloon supplied with motive power. His professional aëronautical training has been doubtless of service to him in preventing those continual accidents and narrow escapes which have befallen others, who, though ingenious and daring, have been but amateurs in balloon management. It is the meteorological conditions for the success of his experiment are not so frequently experienced in the British capital as in the French one, and certainly the conditions of the calms essential for navigable balloon return journeys have been very muc in the minority during the fitful, when not tempestuous summer of the present year. The attempted feat of rounding the dome of St. Paul's is not an impossible one, even in our insular climate. After all it is *par excellence*, a climate of samples. If the right sort of day is awaited long enough, it must come at last.

M. Santos Dumont's Present to the French Government.—Just when the aëronautical world was awaiting with eager expectation M. Santos Dumont's promised experiment in his omnibus balloon, he took its breath away by presenting his navigable balloons to the French Government. The cause of thus enriching the resources of the French Army appear to have been the result of M. Santos Dumont's manœuvres in his airship above the Review ground at Longchamps on July 14. On this occasion the Brazilian aëronaut saluted the President of the Republic from mid-air by firing revolver shots. It has been stated that it was the reception given to M. Santos Dumont on that day which so touched his heart as to make him determnie to repay the nation which had taken so keen an interest in

his work by the gift of his world-famed aircrafts.

Aëronautical Exhibitions.—In connection with a collection of aëronautical apparatus on view at the Alexandra Palace, it has been stated that it is the first attempt at an aëronautical exhibition in this country since 1868, when the Aëronautical Society of Great Britain inaugurated their exhibition at the Crystal Palace. This, however, is not an historical fact. For instance, in 1885, in days when exhibitions were still organised with premeditated care, and had, on that account, a real scientific value, the Aëronautical Society of Great Britain, in conjunction with the executive of the Alexandra Palace, carried out an exhibition. At this exhibition the jurors were Professor H. S. Hele-Shaw, C.E., Mr. H. Tingle A.I.C.E., Mr. E. A. Barry. There were nine classes in this Exhibition and it included models for the accomplishment of aërial navigation by mechanical means only, models for attaining the same object by mechanical means and buoyancy combined, light motors, models of navigable balloons, balloon materials and appliances for propulsion, miscellaneous objects of interest connected with aëronautics, instruments of measurement, relics, photographs taken from balloons, meteorological instruments suitable for balloon ascents. There were balloon races at this Exhibition, foreshadowing the already historic balloon competitions at Vincennes. In connection with this Exhibition the official report said "it would be hard to surpass the ingenuity and perseverence displayed by most of the exhibitors." To pass to later times, not three years ago there was an aëronautical section at the Naval and Military Exhibition at the Crystal Palace, when the management called in the assistance of both the Government and the Aëronautical Society of Great Britain. Amongst the exhibits were two balloons difficult indeed to surpass in their historic value. One was the shell-pierced balloon which ascended during the siege of Ladysmith, whose occupants directed the fire of the British artillery and did more for the defence of our Empire than has been generally supposed. The other was the historic balloon. "La Volta," in which the great French astronomer, M. Janssen, made his escape from the beleaguered capital of France to go on an astronomical expedition at the time of the Franco-Prussian War.

Count Henri de La Vaulx's Balloon Journey from Paris to Hull.—Count Henri de la Vaulx ascended in a balloon on Saturday afternoon at St. Cloud and crossed the English Channel at its upper portion. The wind was light from the south-south-east at the start, and during the passage. The descent was made near Hull.

Professor Langley's Airship Model.—The *New York Herald* lately gave an illustrated account of the launching of Professor Langley's twelve-foot model from the top of the Langley house-boat at Widewater. It appears that it flew a distance of six hundred yards, and then sank in twenty-two feet of water. It was, however, rescued, though, after its immersion, it is described as a tangled wreck of twisted wire and silk wings. The time of the flight is stated to have been 45 seconds. Its course in the air was in a semi-circle. The airship was driven by an 8-horse power naphtha motor, connected with two two-bladed propellers on each side of the machine, and one four-bladed wind vane rudder immediately behind the engine in an upright position, just behind this being the rudder proper. The airship was supported by a pair of white silk wings on each side 4½ feet in length by 2 feet in width. The propellers were on the side between the wings, revolving towards each other. The wings, steering apparatus, motor, and other running gear were attached to a central cylindrical tube of aluminium 18 inches in length and 5 inches in diameter.

Foreign Aëronautical Periodicals.

(In this list a selection of some of the most notable articles is given.)

L'AÉRONAUTE (Paris).

May, 1903.—"Ascension du ballon le Galilée le 4 Novembre, 1870" M. Hurson.

July.—Ascension du 14 Juillet; les prix obtenus; récit du voyage de L'Archiméde; M. Blanchet.

August.—Lettre de M. Wenz sur les Cerf-volants.

L'AÉROPHILE (Paris).

April, 1903.—Portraits d'Aéronautes contemporains: Claude Jobet; A. de Masfraud. L'Aéronat Lebaudy.

ILLUSTRIRTE AËRONAUTISCHE MITTHEILUNGEN (Strassburg).

April, 1903.—Die Luftschiffahrt in Japan von H. W. L. Moedebeck.

May.—Neues zur Katastrophe Bradsky.

June.—Winddruckmesser von H. R. v. L.

July.—Hargraves neuere Versuche.—

August.—Wiederholte erläuterung des Schwebefluges.—Neuer erfolg des Luftschiffes

von Lebaudy.—Uber den Mediterraneen des Grafen de la Vaulx.

September. — Joseph Maximilian Freiherr v Lütgendorf, de erste deutsche Luftschiffer, von Max Leher-Augsburg.

WIENER LUFTSCHIFFER-ZEITUNG (Vienna).

April, 1903.—Hauptmann Josef Frib.—Die Ballonphotographie.

May.—Graf de la Vauix.—Die Gleitversuche der Brüder Wright.

June.—Der Ballon Lebaudy.—Uber Gleitmaschinen.—Zur Lufthügelauftriebstheorie.

July.—Die neue sensationsfahrt des Wiener Aëro-klubs.—Vademekum zür erfinder.—Die Hebeschraube.

August. — Die erste Nachtfahrt, 1903; Hubert Silberer.

September. — Eine solo-Nachtfahrt im "Saturn"; Hubert Silberer.-Uber experimentelle Luftstauhügel.

L'AERONAUTIQUE BELGE (Brussels).

May, 1903.—Traversée de l'Atlantique en Ballon.

July. — Les Combustions spontanées de Ballons.

September.—La Résistance de l'Aer. — La Théorie du Cerf-volant.

Notable Articles.

1903.

Apl. 4. *Daily Graphic.*—"Colonel Cody's Kites" (Illustrated.)
— *Weekly Budget.*—"Sounding the Aërial Ocean."
20. *Daily Mail.*—"Aëronaut's Wild Flight."
May — *Review of Reviews.*—"When Shall We Fly?"
19. *Manchester Guardian.*—"The Science of Kite Flying."
23. *The Sphere.*—"The Kite in Modern Warfare." (Illustrated.)
29. *Engineer.*—"The Soaring Plane by a Short Method."
June 15. *Daily Telegraph.* — "Racing and Air Flights."
17. *The Sketch.*—"Inside an Airship Factory."
18. *Daily Telegraph.*—"The Ballooning Adventure."
24. *Daily Telegraph.* — "Santos Dumont's Airship."
25. *Echo.*—"Kites."
26. *Daily News.*—"Scientific Kite Flying."
— *Daily Chronicle.*—"Kite Flying."
— *Morning Advertiser.*—"Kite Flyir g on the Sussex Downs."
— *Evening News.*—"Battle of the Kites."
29. *Morning Leader.*—"The Flotilla of Kites."
31. *Daily Chronicle.* — "Atmospherical Research."
July 2. *Nature.*—"The Kite Competition of the Aëronautical Society."
4. *Illustrated Mail.*—"Striking Experiments by Scientific Kite Flyers." (Illustrated.)
6. *New York Herald.*—"Narrow Escape of M. Santos Dumont."
10. *British Photography.*—"Kite Flying and Photography."
15. *The Tatler.*—"The Gentle Art of Kite Flying." (Illustrated.)
26. *Le Monde Sportif.*—"La Traversée des Pyrénées en Ballon."
28. *Morning Advertiser.*—"A Balloon Competition."
Aug. 5. *The Car.*—"From Cloudland to Earth."
10. *Daily News.*—"Ballooning by Moonlight."
— *Daily Telegraph.* — "Airship Experiments."
— *Standard.*—"The Conquest of the Air."
— *Morning Post.*—"Mr. Bacon's Ballooning Experiments."
12. *The Sphere.*—"The New Hot Air Military Balloon."
21. *Morning Post.*—"Aërial Highways."
26. *The Car.*—"Aëronautics in Warfare."
29. *The Sphere.*—"War Kites at the Naval Manœuvres."
30. *New York Herald.*—"The Conquest of the Air."
Sept. 9. *The Car.*—"A Lady's First Ballooning Experience."
18. *Daily News.*—"The Airship's Voyage."
— *Globe.*—"Mr. Goossen's Balloon Journey." Letter to the Editor.
— *Evening News.*—"The First Flight."
— *New York Herald.*—"Mr. Stanley Spencer's Flight Over London."
21. *Daily Mail.*—"15,000 Feet Above the Alps."
22. *Daily Chronicle.* — "Count Zeppelin's Airship."

Applications for Patents.

(*Made in July, August, and September.*)

The following list of Applications for Patents connected with Aëronautics has been specially Compiled for the AËRONAUTICAL JOURNAL by Messrs. BROMHEAD & Co., Patent Agents, 33 Cannon Street, London, E.C.

15139. July 8. WILLIAM BEEDLE. **Improvements in the means of steering Airships, and mechanism for controlling same.**

15158. July 8. GEORGE EDWARD WADE. **A Machine (contrivance or vehicle) for Aerial Navigation.**

17651. August 14. JOHN FREDERICK DUKE. **Improvements in and relating to Airships or vessels, and the like.**

17743. August 17. FRANCIS ALEXANDER BARTON and FREDERICK WALKER. **An equipoise for Airships and like Apparatus for Aerial Navigation.**

18768. August 31. MAX BOURCART. **Improvements in Flying Machines.**

18920. September 2. FRANCIS ALEXANDER BARTON. **Improvements in Flying Machines.**

19347. September 8. WALTER ACWORTH GREEN. **Improvements in and relating to Flying Machines and the like.**

19672. September 12. GEORGE DAWE. **Improvements in Aerial Machines.**

AËRONAUTICAL SOCIETY OF GREAT BRITAIN.

FOUNDED 1866.

PRESIDENT - MAJOR BADEN-POWELL, SCOTS GUARDS

COUNCIL, 1903

SIR EDWIN ARNOLD, K.C.I.E., C.S.I.
MAJOR BADEN-POWELL, SCOTS GUARDS (*President*).
E. A. BARRY, ESQ., J.P., F.S.A.
ERIC STUART BRUCE, ESQ., M.A. (*Hon. Secretary*).
THE EARL OF CRAWFORD AND BALCARRES, K.T., LL.D., F.R.S.
SIR WILLIAM CROOKES, F.R.S.
DR. LESLIE EARLE, M.D.
E. P. FROST, ESQ., J.P., D.L.
LT.-COL. FULLERTON, ROYAL ENGINEERS.
SIR HIRAM S. MAXIM.
MAJOR H. C. ROBERTS.
W. N. SHAW, ESQ., Sc.D., F.R.S.
LT.-COL. TEMPLER, INSTRUCTOR IN BALLOONING.
LT.-COL. F. C. TROLLOPE (LATE GRENADIER GUARDS).
LT.-GEN. SIR CHARLES WARREN, G.C.M.G., K.C.B., R. ENG.

The Society is established for the purpose of giving a stronger impulse to the Scientific study of Aërial Navigation; to promote the intercourse of those interested in the subject at home as well as abroad; and to aid with advice and instruction those studying the subject.

Any person desirous of becoming a member is requested to communicate with the Hon. Secretary, on the form of application as overleaf.

P.T.O.

*Christian and Surname*_____

*Rank or Profession*_____

*Address*_____

*Date*_____ 19

SIR,

Please to propose my name as a Member of the Aëronautical Society of Great Britain.

If elected, I undertake to pay the subscription of One Guinea per annum (unless I shall give previous notice of withdrawal), or to compound for my annual subscriptions by the payment of Ten Guineas, and to abide by the Rules of the Society.

*(Signature)*_____

To ERIC STUART BRUCE, ESQ.,

Hon. Sec. Aëronautical Society,

53, VICTORIA STREET, WESTMINSTER, LONDON, S.W.

MAN-LIFTING and other

KITES

(Baden-Powell Patent).

In various sizes. Usual size 12 ft. × 12 ft. (of which 4 to 6 will lift a man) price £2 7s. each; 6 ft. × 6 ft. (for registering instruments, &c.), £1 5s. each.

JOHN J. JACKSON,

YACHT AND CANOE SAIL MAKER,

NORTHWICH, CHESHIRE.



Revue Mensuelle

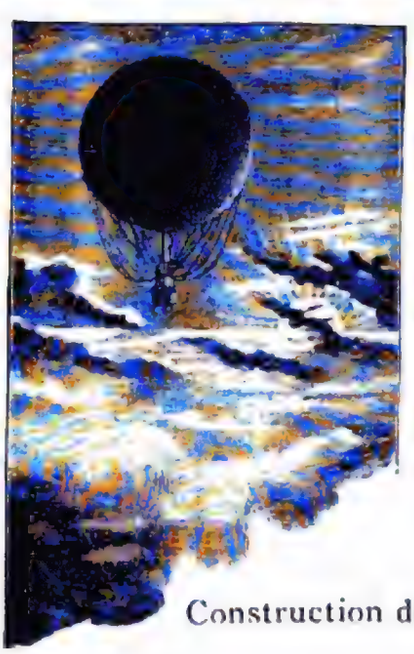
ILLUSTRÉE, DE

l'Aéronautique

Et des Sciences qui s'y rattachent.

Publiee avec la collaboration des principaux savants francais et etrangers.

Rédaction et Administration: —14, Rue des Grandes-Carrières, PARIS.
Téléphone 503-24.



GEORGES BESANCON,

OFFICIER d'ACADEMIE,

INGENIEUR AERONAUTE.

Expériences et ascensions scientifiques.

Voyages aériéns d'amateurs.

Exploration des hautes régions de l'atmosphère par ballons sondes et Cerfs-Volants.

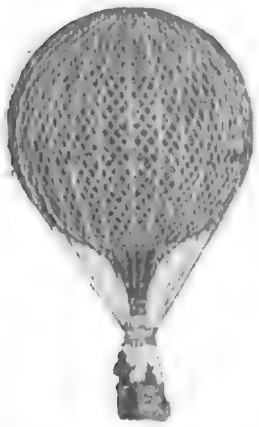
Construction de tous les appareils concernant la locomotion aériénne.

14 Rue des Grandes-Carrieres 14, PARIS, MONTMARTRE.

Addresse télégraphique :—BESANCON, AERONAUTE, PARIS.

C. G. SPENCER & SONS,

BALLOON MANUFACTURERS,



GAS BALLOONS, HOT-AIR BALLOONS,

AIR-SHIPS,

Parachutes, Captive Advertising Balloons,

GOLD BEATERS' SKIN BALLOONS AND FIGURES,

India-Rubber Toy Balloons and Paper Montgolfier Balloons.

Price List or Quotations on Application.

Our new-specially-erected Premises form the Finest Balloon Establishment in the World, and afford the requisite facilities to enable us to execute orders of any magnitude.

56a, HIGHBURY GROVE, LONDON, N.

SPENCER BROTHERS, Aeronauts,

For Public and Private BALLOON ASCENTS Seats may be booked in the Car (fee £5) for forthcoming ascents.

CAPTIVE BALLOONS for Exhibitions, &c.

PARACHUTE DESCENTS by Lady and Gentlemen Parachutists.

45b, ABERDEEN PARK, HIGHBURY, LONDON, N.

Telegraphic Address: "Aeronaut, London." Telephone: 1893 Dalston.

ILLUSTRIRTE

AERONAUTISCHE MITTHEILUNGEN

Fachzeitschrift für alle Interessen der Flugtechnik mit ihren Hülfswissenschaften, für aëronautische Industrie und Unternehmungen.

(Illustrated Aeronautical Record)

Quarterly Journal of Aeronautics.

With the collaboration of the Aeronautical Societies of Munich and of the Upper Rhine (Germany).

Edited by Dr. R. EMDEN.

Price per Annum (4 Nos.) - - - - - - - 6s. 10d., post free.

The three numbers issued will be sent post free for 4s. 6d.

Orders to be sent to Mr. DAVID NUTT, 270, Strand, London, W.C. or direct to the Publisher, Mr. KARL T. TRUBNER, Strassburg (Germany)

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google